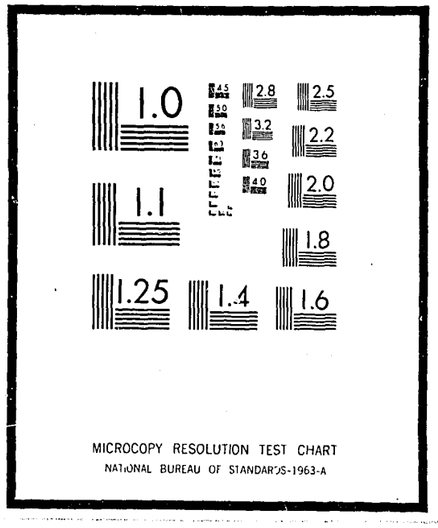

LAW ENFORCEMENT STANDARDS PROGRAM

PROJECT PLANS FOR FISCAL YEAR 1973
of the
LAW ENFORCEMENT STANDARDS LABORATORY

prepared by
Institute for Applied Technology
National Bureau of Standards

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U.S. DEPARTMENT OF JUSTICE
Law Enforcement Assistance Administration
National Institute of Law Enforcement and Criminal Justice

FOREWORD

In accordance with Title I, Section 402(b) of the Omnibus Crime Control and Safe Streets Act of 1968, P.L. 90-351, the National Institute of Law Enforcement and Criminal Justice (NILECJ) has established the Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards.

LESL is conducting research leading to the development and promulgation of national voluntary equipment standards that will assist law enforcement and criminal justice agencies in the selection and procurement of quality equipment. In addition to standards development, LESL is defining minimum performance levels and developing methods for measuring the required performance of equipment designated by NILECJ.

The 1973 Project Plan for the Law Enforcement Standards Laboratory outlines the approved research objectives and plans for the coming year. The program of testing and evaluation outlined in the project plan has significant value for law enforcement and criminal justice agencies in the selection and procurement of quality equipment. This plan is intended to give you detailed information concerning this program so that all concerned agencies are alerted to upcoming research developments.

A Standard for police body armor and a report on emergency vehicle warning devices and batteries for law enforcement use have been distributed. Copies of these items may be obtained from the National Criminal Justice Reference Service, Law Enforcement Assistance Administration, U.S. Department of Justice, Washington, D.C. 20530.

We earnestly solicit your comments and suggestions regarding this plan and future efforts in this area.

MARTIN B. DANZIGER
Assistant Administrator
National Institute of Law Enforcement
and Criminal Justice

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Jacob J. Diamond, Program Manager
Protective Equipment Standards

Project Plan for Bullet and Impact Protective Equipment

BACKGROUND

In 1960, 28 policemen were murdered. In 1971, the number was 126, an increase of 450 percent. This amounts to an annual rate of increase of 15 percent compounded. Ninety-five percent of these murders were committed with firearms. These statistics highlight the need of law enforcement officers for equipment items to protect them against gunfire.

A variety of bullet-protective items are now available, including body armor, handheld shields, ballistic helmets, bullet resisting motorcycle windshields and clipboards, transparent and opaque patrol car armor, etc. A great variety of materials are used in these products, and their protective ability ranges from that against small caliber handgun bullets to armor piercing rifle fire.

There is much confusion about the capabilities of these items and a consequent need for objective evaluations, unbiased information, and detailed guidance.

Paralleling the increase in police murders in recent years has been an increase in civil disorders. This has created an increased need for items such as riot helmets, shields, and outercoats which protect against impact by clubs and thrown missiles rather than bullets. While helmets used by motorcycle police and officers in highway patrol cars are intended mainly to protect against accidental rather than intentional injury, they are quite similar to riot helmets in function.

PROPOSED PLAN

Because of the large number of items involved, and their life-and-death importance to law enforcement officers, LESL has established a small group which is wholly dedicated to the needs of NILECJ and LESL in this product area. Individual equipment items will be addressed in the priority order as established and modified by NILECJ. The initial group of standards being developed includes police body armor, helmets, and handheld shields, in that order.

Since there are a relatively small number of brands and models of ballistic-protective items on the market, and since the police are vitally concerned with the performance of each one of them, we propose to evaluate most or all of them during the testing phase that will normally precede the drafting of each standard.

Standards development process

For each equipment item, the following sequence of tasks will be performed.

(1) Survey the market and state-of-the-art of test methodology. This will involve determining what products are available, what standards are in existence, which performance characteristics are relevant to the user needs, and what methods of test are available.

(2) Adapt existing test methods if suitable ones are available.

(3) Develop new test methods if necessary.

(4) Test existing hardware to validate the selected methods.

(5) Based on user needs and the accumulated test data, draft a standard incorporating the selected test methods and suitable levels of performance.

OBJECTIVES

The objectives of this project are the development of performance standards for impact protective helmets and bullet protective shields. Substantial progress will also be made on the development of standards for bullet protective helmets and for face shields. The projected milestones are given in the attached table.

LEVEL OF EFFORT

The $100,000 budgeted for this project will support a three-man group consisting of a project engineer, a junior professional and a technician. This is a modest increase over the $80,000 expected to be spent in FY-72.

REMARKS

This project has produced the first standard to be promulgated by NILECJ, that on the Ballistic Resistance of Police Body Armor. It has also, as a by-product of the validation of an impact test procedure for riot helmets, produced test data showing that two riot helmet models being sold to the police afford poor protection against impacts to be expected in riot situations.

BULLET AND IMPACT PROTECTIVE EQUIPMENT

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Standard on Impact Protective Helmets	Continuing	Completed	July 72	Sept. 72	Feb. 73
Standard on Bullet Protective Shields	Continuing	Completed	Sept. 72	Nov. 72	April 73
Standard on Bullet Protective Helmets	Continuing	Completed	Nov. 72	Feb. 73	July 73
Standard for Face Shields	Sept. 72	Nov. 72	May 73	Aug. 73	Jan. 74

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Protective Equipment Standards

Project Plan for Evaluation of the Wounding Potential of Non-Penetrating Bullet Impacts on Police Body Armor

BACKGROUND

The purpose of body armor is the protection of the wearer against injury from gunfire. Body armor performs its most important function if it is not penetrated by a bullet and thus prevents the bullet from entering the body of the wearer.

The possibility still exists however that a bullet can cause injury even if it does not penetrate. Modern police body armors may be made of any one of several ballistic materials, such as multiple layers of high tenacity nylon, thin sheets of steel, steel and nylon in combination, rigid plastics, and fiber reinforced plastics.

All of these materials deform to a greater or lesser extent when they are hit by a bullet. Nylon undergoes considerable deformation over a fairly large area and then recovers fully. Steel undergoes a largely permanent deformation in a much smaller area. The plastics in general deform less than nylon or steel.

If body armor is worn so far from the body that the skin is not touched by the armor even at its maximum deformation, there is evidently no danger of local impact injury. Any possible injury would be that due to absorption of the bullet's kinetic energy by the wearer's body as a whole.

It is not at all clear however what the effects would be if armor is worn closer to the body, especially under the shirt. Injuries sustained could be simple bruises, or they could be splintered ribs, ruptured internal organs, or cardiac arrest. This project is intended to answer this basic question.

PROPOSED PLAN

Phase 1--Some data on the maximum deflection of police body armor as a result of ballistic impact have already been obtained. However, we have no information on the time dependency of this deformation. We propose to attach an accelerometer to the rear surface of a test armor panel,

impact the armor with a bullet of known mass and velocity, and measure the resultant acceleration as a function of time using an oscilloscope. This experiment will be repeated with each of the important materials used in police body armor, and enough bullet masses and velocities to cover the range of impact energies encountered in police operations.

This information will be evaluated by physicians expert in the field of impact trauma and characterized by them in terms of hazard to the armor wearer. It is expected that there will be a grey area of uncertainty between impacts which are clearly non-damaging and impacts which will result in various types of damage to the body.

Direct testing of animals will be used to resolve this grey area of uncertainty.

This plan is designed to give the maximum amount of information for the least amount of money and with the minimum amount of animal testing. In addition, the objective testing phase of the project is designed to result in a test which can be incorporated into a revised NILECJ standard for police body armor.

Phase II--In order to supplement the information obtained in Phase I, which is the major effort, it is planned to do a very limited amount of testing on instrumented animals.

It is postulated that damage to internal organs is the direct result of the pressure shock wave caused by bullet impacted armor. We propose to test this postulate directly by embedding pressure transducers near internal organs in the body of an animal, and subjecting it to impact using a suitable armor-bullet combination.

The first trial would be made using nylon armor and a .38 Special, 158 grain lead bullet. This combination is considered to be of greatest immediate interest, since it involves the most widely used police handgun, one of the most available undercover armors, and a combination known to result in a large ballistic deformation.

A second trial would be similar to the first, except for the substitution of a steel armor for the nylon. If the results of these two trials prove to be significant, a third armor-bullet combination would be evaluated.

OBJECTIVES

This project would result in a body of test data incorporated in one or more reports.

If the results disclose an unacceptable hazard associated with armor deformation, the project will also result in a test method and performance level which can be used to assess this hazard.

At the conclusion of this project, NILECJ Standard 0101.00 on the Ballistic Resistance of Police Body Armor will be revised to incorporate the results obtained.

The projected milestones are given in the attached table.

LEVEL OF EFFORT

None of the testing described above will be performed at NBS. A contract for the performance of Phase I is being negotiated, with the cost expected to be about $19,000.

Phase II will be performed at the U.S. Army Wound Ballistic Laboratory at Edgewood Arsenal, at a cost of $3,000 per test, for a total of $6,000.

Total Budget:	Phase I =	$19,000
	Phase II =	6,000
	Total	$25,000

REMARKS

This is a project plan for an on-going LESL project in the Protective Equipment Standards program. It will be funded entirely from FY-72 funds already transmitted to LESL by NILECJ.

EVALUATION OF THE WOUNDING POTENTIAL OF
NON-PENETRATING BULLET IMPACTS ON POLICE BODY ARMOR

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Report on Phase I	Continuing	Aug. 72	Sept. 72	Oct. 72	Nov. 72
Report on Phase II	Continuing	Aug. 72	Oct. 72	Nov. 72	Dec. 72
Revision of Standard on Police Body Armor	Continuing	Dec. 72	--	Feb. 73	July 73

*Milestone 1 Completion of the survey of existing equipmant, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Protective Equipment Standards

Project Plan for
Hearing Protectors for Use on Firing Ranges

BACKGROUND

It is well known to everyone that loud noises can be unpleasant or even painful. It is not as well known that loud noises can cause permanent deafness.

The hazard to the hearing depends, among other factors, on the loudness of the noise, whether it is continuous (like a jet noise) or impulsive (like gunfire), its duration, its rate of repetition (if impulsive), and the susceptibility of the individual.

Deafness caused by gunshot noise manifests itself first by a gradually decreasing ability to hear sounds of the higher frequencies. Since speech intelligibility depends mainly on the middle frequencies, a person may have lost a considerable portion of his hearing before he realizes he is having trouble hearing, has his hearing tested, and finds out he is partially and permanently deaf.

This has happened to many servicemen, and to many people who shoot as a hobby. Law enforcement officers, who are required to practice their shooting on the firing range, must protect themselves if they are not to suffer similar irremediable hearing losses.

Many means are in use to protect the hearing, including earmuffs and ear plugs of many types, cotton, the fingers, and empty .38 Special cartridge cases. Information on the effectiveness of the variety of available devices, and guidance in their procurement and use, should be of interest to every law enforcement officer.

PROPOSED PLAN

Interim standard

There is an American National Standard method for measuring the effectiveness of hearing protectors (Z24.22-1957) as well as two military specifications for these devices (MIL-P-38268B, March 1971, and MIL-STD-1431, Sept. 1969). The ANSI standard is now undergoing revision by ANSI Committee S3-52 on Hearing Protectors. This revision has been in process for several years and it is expected to be at least another year before the revised standard is available.

The plan is to draft an interim NILECJ Standard based on the existing ANSI test method and to incorporate some improvements which seem to be acceptable to the ANSI Committee as well as some they have not yet considered. This will serve the needs of the law enforcement community for a standard right now.

Unfortunately the ANSI test method has some disadvantages for this application which make it unacceptable for use in a permanent NILECJ standard. It uses ten human subjects as "listeners," requires the use of an anechoic chamber and elaborate electronic equipment, takes a great deal of time and care, and is thus very expensive. Most importantly, however, the test is designed for and has been validated for protection against continuous noise rather than gunshot noise.

The plan therefore includes the development of a test which will be more rapid, much less expensive, completely objective, and deal specifically with gunshot noise.

Measurement of gun noise

In the first phase of the experimental program, the actual loudness and duration of the noise made by various police firearms will be measured using high precision microphones and oscilloscopes. This will be done at various distances and directions from the guns, and in both outdoor and indoor firing ranges. The resultant body of data will provide a quantitative assessment of the hazard to the law enforcement officer.

Development of test method

The second phase of the experimental program is the development of a test method which will determine the attenuation of an earmuff directly by placing a microphone under the earmuff and next to the ear opening. If feasible, a headform of suitable material will be used instead of a living human head.

Revised standard

Based on this experimental work, a second NILECJ standard will be drafted. The level of attenuation will be based on the measured capabilities of available earmuffs and the preliminary criteria for hearing damage due to impulsive noise proposed by the National Academy of Sciences-National Research Council Committee on Hearing, Bioacoustics, and Biomechanics, Working Group 57.

While it is evident that the proposed method will not evaluate the effectiveness of earplugs of any type, this is not considered to be pertinent. At law enforcement firing ranges, the preferred practice is to require the use of earmuffs which belong to the department and which are kept at each firing station.

Standards review committees

The two standards (interim and revised) resulting from this project will be subjected to full NBS and NILECJ review, including review by users and manufacturers. Since the first (interim) standard is an adaptation of a consensus standard, a Standards Review Committee for this standard will consist of representatives of the three committees now working in the Hearing Protector area: ANSI Committee S3-52, ANSI Committee Z137 and IEEE Committee GA and E, WG30.10. For consideration of the second (revised) standard, the Committee will be augmented with independent experts and manufacturers' representatives.

OBJECTIVES

This project will result in the development of two standards for hearing protectors, an interim standard and a revised standard. The projected milestones are given in the attached table.

LEVEL OF EFFORT

This work is being done in house in NBS and is funded at a level of $40,000. $28,000 was allocated from FY-72 funds, and $12,000 is requested for FY-73 to complete the project.

REMARKS

The first NILECJ Standard on Hearing Protectors for Use on Firing Ranges has already been transmitted to NILECJ for review and promulgation. The first phase of the experimental program, the measurement of gun noise, is now in progress.

HEARING PROTECTORS FOR USE ON FIRING RANGES

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Revised Standard on Hearing Protectors	Continuing	Completed	Oct. 72	Jan. 73	June 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Protective Equipment Standards

Project Plan for
Anthropometric Study of Law Enforcement Officers

BACKGROUND

Anthropometric measurements are the dimensions of the human body and of its parts. Such measurements, when taken on a statistically significant sample of a population, serve to characterize that population and form the data base on which rational decisions can be made concerning the dimensional design of items to be used by that population.

Much of the anthropometric data now available are based on studies of military personnel and students while some are representative of the general population. No study has ever been made of law enforcement officers. Since officers as a group are preselected for size and strength, it is evident that they form a special population with its own special characteristics.

The human body has a great many dimensions on which measurements can be and have been made for specific purposes. No "complete" anthropometric study is possible; a selection must be made. For the purposes of law enforcement equipment standardization, data are needed relevant to (1) police body armor, (2) helmets, (3) gas masks, (4) hearing protectors, (5) firearm grips and triggers, (6) patrol car seating, (7) uniforms and other clothing, etc.

PROPOSED PLAN

The anthropometric study of law enforcement officers is a large undertaking and is planned on a task basis.

Task I will provide the planning, and will include a search for applicable published data, a survey of manufacturers to ascertain the anthropometric basis for their sizing practices, the design of a sampling plan, and the design of a detailed plan for performing the remaining tasks in the plan.

Task II will provide anthropometric data on the torso, as needed for the sizing of police body armor.

Task III will do the same for the head, as needed for helmets, gas masks, hearing protectors, standard headforms, etc.

Task IV will address the hands, with reference to gun use, glove size, etc.

Task V will address the seated person, with reference to patrol car and other vehicle seating.

OBJECTIVES

The initial effort is expected to include Tasks I and II. The outputs will consist of a final report for each task. The projected milestones are given in the attached table.

LEVEL OF EFFORT

It is estimated that the proposed funding of $50,000 will be adequate to fund Tasks I and II. This is very uncertain, since the contracts will be let by competitive bidding. Possible bidders are the Harvard School of Public Health and the Antioch College, Anthropology Dept.

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Report on Task I	Oct. 72	Jan. 73	--	Feb. 73	Mar. 73
Report on Task-II	Oct. 72	--	July 73	Sept. 73	Oct. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Protective Equipment Standards

Project Plan for a
Survey of Police Clothing

SCOPE

This project consists of the assembly of the conceptual and factual basis for the rational planning of a clothing standards program. It comprises a survey of the clothing attributes relevant to police missions and of the means required and already available to evaluate these attributes.

BACKGROUND

Broadly considered, the usual clothing or uniform of the law enforcement officer is part of his protective equipment. It protects him against the cold, the sun, the rain and the heat. It also protects him against the bruises, cuts, abrasions and to some extent the impact injuries caused by thrown missiles, hand-to-hand combat, and the other hazards encountered on his varied missions.

The benefits bestowed by clothing have their costs in terms of the weight to be carried, the restraint of freedom of motion and the metabolic cost and performance diminution which these entail.

One of the most important goals in setting standards for clothing is to optimize it from an operational point of view by effecting the proper balance between the protection afforded and the costs in difficulty or limitation of action.

PROPOSED PLAN

Much work has been done on clothing by the Army Quartermaster Corps and the Army Institure of Environmental Medicine, and much information on impact effects has been gathered from accident studies and experiments on blunt trauma. We plan to assemble and evaluate this and other relevant material.

The state-of-the-art of high performance textiles will be assessed from the point of view of the protection affordable against impact and laceration injuries.

The test methods needed and those already available to evaluate the performance of clothing will be identified.

Most importantly, an effort will be made to identify all performance attributes which are even marginally germane to the varied activities of law enforcement officers.

OBJECTIVES

The sole objective of this preliminary project is a report on the state-of-the-art. The projected milestones are given in the attached table.

LEVEL OF EFFORT

This project is budgeted at $30,000. It will be done on contract by a non-NBS group; possible bidders are the Gillette Company Research Laboratories and the Franklin Institute.

SURVEY OF POLICE CLOTHING

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Report on Police Clothing	Nov. 72	Feb. 73	--	April 73	May 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Protective Equipment Standards

Project Plan for Handcuffs

BACKGROUND

Handcuffs are among the basic items of equipment routinely carried by essentially all law enforcement officers. In addition to the metal manacles which have been in use for generations, a single-use plastic variety has recently come into use, mainly in situations where large groups or mass arrests are anticipated.

PROPOSED PLAN

The basic performance characteristic which must be evaluated is the breaking strength of the ratchet-locking mechanism and the linkage joining the handcuffs. Other attributes which will be evaluated are the ability of the handcuffs to withstand picking, their weight, the suitability of the locks, and the possibility of their causing intentional, accidental or self-inflicted injury to the prisoner.

OBJECTIVES

The objective of this project is the development of a single performance standard covering all handcuff varieties deemed of merit. The projected milestones are given in the attached table.

LEVEL OF EFFORT

This project is budgeted at $40,000 and will be done in-house at NBS.

HANDCUFFS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Handcuff Standard	Sept. 72	Oct. 72	Dec. 72	Feb. 73	June 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager

Project Plan for
Standard Reference Collections of Forensic Materials

SCOPE

This project comprises a survey of the state-of-the-art and detailed planning for the establishment of the required reference collections.

BACKGROUND

Included in the physical evidence obtained at the scene of a crime may be such items as paint chips, glass fragments, wood slivers, textile fibers, hairs, etc. The basic task of the forensic scientist then is to establish a link between the suspect and the scene of the crime by demonstrating that the evidential material matches an item associated with the suspect. This is usually accomplished by low power microscopic matching of the two items involved, and does not require a reference collection.

Standard reference collections help the forensic scientist to identify and to indicate the origin of the evidential material in those cases where a suspected matching item is not available. This is normally done by measuring some characteristic of the evidential material, consulting a compendium to tentatively identify it as one of several possible varieties, and then confirming its identity by comparing it to actual specimens of the possible varieties obtained from a standard reference collection. The collections thus help the investigator to find the suspect rather than to prove the link between the suspect and the crime.

The usefulness of a standard reference collection increases with its completeness and with its demonstrable integrity. Most individual forensic scientists and laboratories must operate without reference collections or with small, incomplete ones which they gather themselves. This is a serious handicap to them and they frequently voice the need for ready access to complete, recognized reference collections.

PROPOSED PLAN

Before the rational planning of projects to establish standard reference collections can proceed, many questions must be answered. Those materials of interest to forensic science must be clearly identified; existing collections must be located, and the possibility of their incorporation into a master collection must be ascertained; means of establishing each material collection must be established; the necessity and the mechanism for keeping each one current must be established; the desired content, the classification scheme, and the characteristics of interest must be established for each material; the availability of a suitable compendium of characteristic values must be investigated; how should these collections be made available and to whom--sold as a collection, or individual items sold or given free to validated requesters; who should "housekeep" each collection--NBS, the American Association of Forensic Sciences (AAFS), ASTM, or some major forensic laboratory with a special interest in the particular material.

The answer to these and other questions must be answered by the forensic scientists concerned before planning can proceed. It is the purpose of this project to survey the situation and to provide enough answers to guide future work.

OBJECTIVES

The single projected output of this project is a report on the state-of-the-art. See the attached table for the projected milestones.

LEVEL OF EFFORT

This project is budgeted at $30,000. It may be done in-house at NBS or contracted out. If contracted out, likely bidders are the Stanford Research Institute, and the AAFS.

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Report on Standard Reference Collections	Oct. 72	March 73	--	June 73	Oct. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Base Station and Transceiver Standards

SCOPE

The items of equipment involved in this project are the transmitters, receivers and antennas that are components of the typical base stations, mobile transceivers and handheld transceivers used by the law enforcement community. Nine draft standards will be prepared and submitted to NILECJ.

BACKGROUND

This project was established to develop standards to assist law enforcement agencies in the selection and procurement of the basic items of communications equipment. As society in general and the police in particular became more mobile, the demand for more and better communications equipment increased. Many agencies now require constant communications with the dispatcher by all officers on duty. As their requirements increased, these agencies have purchased new and more sophisticated communications equipment. Recent technological advances in communications, meanwhile, have resulted in many improvements, notably in miniaturization and packaging. These advances have made communications equipment easier to build, more reliable in the field and less costly. These factors, plus the requirement that this equipment be of the proper frequency, size, durability and reliability to perform satisfactorily during any emergency, make this project one of the most important ones being conducted by this laboratory. It was also one of the first to be initiated, and is expected to produce nine performance standards.

PROPOSED PLAN

This task was initiated by a review of the products already on the market. There are approximately 50 industrial concerns selling FM 2 way radios today. Some of these companies produce base station equipment. Each year, several of these organizations offer new or improved equipment for sale. Our plan has been to determine the characteristics to be used to describe the performance of each item of equipment being standardized. This necessitated agreement on the technical terms being used by the law enforcement community and the communications

industry. Accordingly, a report on terms and definitions was one of our first products. This report, listing approximately 1,000 of the most common technical terms used in law enforcement communications, was recently forwarded to our sponsor, NILECJ.

We are now working on the selection of characteristics to be used to describe equipment performance. Concurrently, this program will produce the measurement techniques to be used to measure the characteristics decided upon. These techniques will be incorporated into the individual standards after they have been checked out on manufacturers' equipment that has been purchased or is on loan. Some new test equipment has been purchased by NBS to further this portion of the effort, but more test equipment may be needed to support the work on receiver standards.

We are working with the Associated Public-Safety Communications Officers, Inc. in the development of a communications guidelines manual for use in the selection and procurement of communications equipment. This task involves the review of presently used specifications, the drafting of proposed guidelines to be used in typical procurements and the design of improved or modified specification characteristics for incorporation into future specifications.

Some of the typical characteristics that will be examined for standardization are:

Transmitters

1. Power output
2. Frequency stability
3. Sideband spectrum
4. Radiated spurious
5. Audio modulation response
6. Conducted spurious

Antennas

1. Gain
2. Pattern
3. Voltage standing wave ratio
4. Power handling capacity

Receivers

1. Sensitivity
2. Spurious response rejection
3. Intermodulation spurious rejection
4. Oscillator frequency stability
5. Modulation acceptance bandwidth
6. Audio power output
7. Undesired radiated power

OBJECTIVES

base station and transceiver standards, the primary objectives of this project, will consist of ten separate standards and will be written in three phases. The standards will not be frequency limited, but will be applicable to all three established police frequency bands, i.e., 30-50 MHz, 150-174 MHz and 450-470 MHz. In addition to standards, the output from this project has produced a report on technical terms and definitions and will provide a communications guidelines manual. The projected milestones are shown on the attached charts.

LEVEL OF EFFORT

Work on this project is being accomplished by the NBS Electromagnetics Division in Boulder, Colorado. During FY-1973, this will be a $150,000 effort that will produce six draft standards and a guidelines manual. In addition, any draft standards that complete the review process will be revised and published.

The NBS review process for these standards will insure that all interested parties will have an opportunity to comment prior to publication of the completed standard. Among these interested parties are the users (selected policemen, Associated Public-Safety Communications Officers, Inc., International Association of Chiefs of Police), standards groups (Electronic Industries Association, Institute of Electrical and Electronic Engineers, American National Standards Institute, American Society for Testing and Materials) industry representatives (Motorola, General Electric, Radio Corporation of America, etc.), and government agencies (U.S. Forest Service, U.S. Secret Service, and Department of Defense, etc.).

REMARKS

This project was initiated during FY-1971. $165,000 was spent on this project during FY-1972. This funding produced one report and three draft standards and will provide the basis for future years work in this area.

BASE STATION AND TRANSCEIVER STANDARDS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Base Station Transmitters	Continuing	Completed	Completed	July 72	Dec. 72
Standard for Mobile Transceiver Transmitters	Continuing	Completed	Completed	July 72	Dec. 72
Standard for Personal/Portable Transceivers	Continuing	Completed	Completed	July 72	Dec. 72
Standard Measurement Techniques for Evaluating Communications Transmitters	Continuing	Completed	Completed	July 72	Dec. 72
Standard for Base Station Antennas	Continuing	Completed	Aug. 72	Oct. 72	March 73
Standard for Mobile Transceiver Antennas	Continuing	Completed	Aug. 72	Oct. 72	March 73
Standard Measurement Techniques for Evaluating Communications Antennas	Continuing	Completed	Aug. 72	Oct. 72	March 73
Communications Guidelines Manual	Continuing	Completed	—	Jan. 73	April 73
Standard for Base Station Receivers	Continuing	Completed	Feb. 73	April 73	Sept. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

BASE STATION AND TRANSCEIVER STANDARDS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Mobile Transceiver Receivers	Continuing	Completed	Feb. 73	April 73	Sept. 73
Standard Measurement Techniques for Evaluating Communications Receivers	Continuing	Completed	Feb. 73	April 73	Sept. 73

*Milestone 1 — Completion of the survey of existing equipment, standards and test methods, and of details of planning for further work.

*Milestone 2 — Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 — Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 — Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Battery Standard

SCOPE

This project deals with batteries used with law enforcement communications equipment. Of initial interest is the battery used in portable, handheld transceivers.

BACKGROUND

Many police departments, concerned about reducing crime and equally concerned about the safety of their police officers, have increased the number of handheld personal transceivers used by their departments. Cities like Cleveland and Detroit intend to supply each officer with a radio to be carried at all times. This approach, plus the recent advances in battery technology that have resulted in increased battery life and improved battery charging rates, has produced a significant increase in the use of battery powered handheld transceivers by law enforcement personnel. Additionally, the practice of using portable radios that operate with mobile transceivers as repeaters has also contributed to the increased use of this equipment. The concern of the law enforcement community about battery life, chargers, charging techniques, personnel safety and lack of standardization prompted the decision to develop standards for batteries.

The initial work on this project has been directed primarily toward batteries used in handheld transceivers and has consisted mainly of a survey of equipment in use and the types of batteries most commonly used with law enforcement communication equipment. Two publications were written regarding the use, selection and application of communications batteries. These are:

(1) Comparison and Performance Characteristics for Batteries Used with Law Enforcement Equipment, NBS Report 10 722.

(2) Chargers and Charging Techniques for Batteries Used with Law Enforcement Communications Equipment, NBS Report 10 732.

PROPOSED PLAN

As stated above, personnel working on this project have concentrated on a determination of the type of equipment being employed and the kinds of batteries being used. A comparison of performance characteristics of the batteries being used in portable transceivers has been performed. Also completed was a review of battery chargers used and the charging techniques detailed in the literature and used by law enforcement personnel. This work resulted in the publication of the two reports listed above.

We are now conducting tests to verify certain characteristics of typical batteries used in law enforcement. Upon completion of testing, work will commence on the generation of the performance standards for batteries used in handheld law enforcement communications equipment. This standard will include the measurement techniques necessary to evaluate battery performance and will emphasize battery types, battery life and charging characteristics and techniques.

After completion of this phase, work will continue on the other batteries, such as the lead acid storage battery, used with law enforcement communications equipment.

OBJECTIVES

The immediate objective of this project is the development of a performance standard for batteries used with handheld transceivers. If present tests achieve satisfactory results, the draft standard should be ready for NBS review by March 1973. Upon completion of this task, work will be initiated on storage batteries such as those used in police vehicles and on batteries used in base stations as standby power sources. The projected milestones are shown on the attached tables.

LEVEL OF EFFORT

Work on this project will be accomplished by the NBS Electromagnetics Division. The level of funding requested for FY-1973 is $20,000.

REMARKS

This project was initiated in FY-1971 when $24,000 was spent. During FY-1972 $40,000 was spent on this effort which included publication of the two reports listed above.

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Standard for Batteries Used with Handheld Transceivers	Continuing	Completed	Jan. 73	March 73	Aug. 73

*Milestone 1 — Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 — Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 — Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 — Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Voice Scrambling Equipment

SCOPE

This project deals with voice scramblers used with law enforcement communications equipment.

BACKGROUND

Some police agencies place the development of a satisfactory voice scrambler system at the top of their list of required equipment. Others feel that this type of equipment is not needed. Often those agencies that express an urgent need cannot agree on type of equipment required, the scheme of operations or the basic technical characteristics. They further cannot agree on the depth of sophistication required to counter criminal actions or the amount they are willing to pay for such a capability. There appears to be a large tradeoff between capability and cost in this equipment development. It would be unrealistic to purchase an expensive complicated device that is not really needed. Thus it may be necessary to write two sets of standards to give the policemen what they really need. There is also the possibility that the shift from voice to digital communications may eventually obviate the need for scramblers. However, due to the large inventory of voice communications equipment in use by police at present, this possibility seems remote for several years at least. During FY-1972, the technology used in marketable scramblers improved substantially and the requirements for secure law enforcement communications became substantially more demanding.

PROPOSED PLAN

Our plan is to examine those voice scramblers on the market today, investigate each sceme of operation being employed and determine the effectiveness of each technique. We are accumulating literature on scrambler equipment offered to the law enforcement community, and will compile a list of the companies involved and techniques utilized. One of our most comprehensive tasks in the development of these standards is the determination of a means of evaluating the

capability of these devices to accomplish their stated purpose. Objective methods are needed to determine the signal distortion introduced to the overall communications system plus the degree of security provided by the scrambler. This will be accomplished through the design of measurement techniques in order that scrambler systems can be evaluated as to the amount of signal degradation, signal distortion, degree of security, reliability and cost effectiveness. These techniques will then be used to evaluate the overall performance of the basic types of voice scramblers.

NILECJ has initiated two efforts that should provide more definite information on requirements for scramblers within the law enforcement community. One of these is a questionnaire developed by the Technical Analysis Division which is being circulated to selected agencies for comment and which should provide results on a short term basis. The other, a longer range approach which should yield more detailed results, is part of the Equipment Systems Improvement Program. As these programs provide data as to the requirements for voice security systems, the appropriate standard can then be written using the information derived from our evaluation and measurement technique effort.

OBJECTIVE

The objectives of this project are to determine a means of evaluating voice scramblers and, if needed, to develop performance standards for voice scramblers. As an interim goal, we will determine measurement techniques for this evaluation. A report on the results obtained from this work will be published as indicated on the attached schedule.

LEVEL OF EFFORT

This is estimated to be a $20,000 effort during FY-1973. The work on this project will be accomplished by the NBS Electromagnetics Division.

REMARKS

This project was initiated in FY-1971 when $4,000 was committed for this purpose. During FY-1972 $20,000 was earmarked for voice scramblers and these funds have been used as described herein.

VOICE SCRAMBLING EQUIPMENT

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Evaluation Report on Voice Scramblers	Continuing	Jan. 73	March 73	June 73	July 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for
Car Location Systems

SCOPE

This project is concerned with the development of standards for equipment that can be used to determine and keep current the location of police units within a given jurisdiction.

BACKGROUND

Certain police agencies have expressed a need for some type of a vehicle location system. As a rationale, they cite several factors. One of these is the more efficient use of patrol cars in a given district, both from the standpoint of covering territory through proper distribution and from the ability to dispatch the "closest" car to the scene of a crime. The latter should provide a reduction in response time with a corresponding increase in the number of suspects being apprehended at the scene of the crime. Another factor mentioned is that of providing an additional safeguard to policemen. Knowledge of the car location can be used to send help automatically to the correct location in time of stress. Some law enforcement agencies have expressed a strong desire for a completely automatic system while others have stated they would be satisfied with a manual or semi-automatic system. Some want car location only, while others want to be able to locate all policemen, if possible.

PROPOSED PLAN

Car location work is being accomplished by several government agencies and some industrial concerns. As a result, many techniques are being used, and several products are being marketed. Of primary concern is the problem of radio frequency propogation in an urban environment. Testing of several concepts and some prototype equipment in such an environment is being conducted by the Department of Transportation. We are monitoring these tests to obtain data that will be used as a baseline for the LESL standardization work. Additionally, we will continue to

monitor the development of new techniques and equipment by industry. Automatic techniques being used for this purpose include dead reckoning, phase trilateration, pulse trilateration, proximity (commonly called the sign post method), triangulation, LORAN, Omega and Decca. Each of these techniques has advantages and disadvantages that affect its use for law enforcement purposes. Some techniques being considered are not fully automatic and the equipment involved usually is less costly than the equipment required to implement the automatic concepts. These techniques, plus the automatic ones, will be considered and included in a report on car location systems that will be produced by this project. Major standardization work in this area will not commence in FY-1973, primarily due to the lack of a definitive requirement, but somewhat because of the rapidly changing technology and the inability of any system to meet the necessary cost, size and accuracy requirements in an urban environment.

OBJECTIVE

The immediate objective of this project is to review techniques and examine the car location equipment available for law enforcement use in order to prepare a report on car locator recommendations. This report will be published as indicated on the attached schedule.

LEVEL OF EFFORT

This work will be accomplished by the NBS Electromagnetics Division in Boulder. The funding level for FY-1973 will be $15,000.

REMARKS

This project was initiated in FY-1972 and $14,000 has been spent to date.

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Evaluation Report on Car Location Systems	Continuing	Feb. 73	April 73	July 73	Aug. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for
Digital Communications Systems Standards

SCOPE

The equipment involved in this project will be the digital terminal in the police car and its corresponding piece of equipment at police headquaters.

BACKGROUND

The present congestion of the frequency spectrum used by frequency modulation two way police radios dictates that a means of better utilization of this spectrum be found. One of the ways of accomplishing this is to develop and use digital techniques to send messages presently transmitted by voice. Accordingly, the development of digital equipment for this purpose and its purchase and installation has been given a high priority by many law enforcement agencies. Use of digital techniques will not only improve the speed of transmission, it will make more effective use of available bandwidth and provide additional security to transmissions. The use of voice channels cannot be eliminated completely, particularly for calls of an emergency nature, but digital techniques can be used to handle a large majority of the present voice traffic; i.e., those of a routine nature. The use of digital equipment also lends itself to the provision of a permanent record, and it further provides a data transfer capability directly to and from state and national data banks.

PROPOSED PLAN

The approach to this task will consist of several steps. The first will be a quick review of the volume and type of voice message traffic being presently transmitted. This information will be coordinated with the digital message format being used by a majority of equipment manufacturers and the federal government, ASCII, to determine the operational requirements and message characteristics to be used as a working data base. The next step will be to identify the operational, physical configuration and technical characteristics of existing digital communications

equipment to determine their suitability for law enforcement use. A logical projection of equipment capability into the next 2 or 3 years may also be undertaken to better identify the type of equipment that will be available to meet the standard when published. The characteristics of this equipment will be examined to determine which should be standardized.

OBJECTIVES

The primary objective of this project is to develop and publish a performance standard for use by the law enforcement community in their selection and procurement of digital communications equipment. Substantial progress should be made toward this goal during FY-1973. As a minimum, this project will provide data as to the operational requirements and message characteristics needed plus a summarization of the technical characteristics of available and proposed digital equipment to meet these requirements. It should also determine the elements that need to be included in the standard as a means of defining the equipment involved. These products will be included in a digital communications equipment standardization report to be prepared during the fourth quarter, FY-1973.

LEVEL OF EFFORT

The development of the performance standard for digital equipment is estimated to be a two man year, $100,000 project. The funds requested for FY-1973, $50,000, will be used as discussed herein and should provide most of the background material needed to determine the design and performance characteristics of the subject standard. It is anticipated that this work will be done by private industry, preferrably by one of the companies that has done similar work for the Department of Defense. Companies that are qualified include ARINC, SDC, and Logicon.

REMARKS

At the requested funding level, this is approximately a two year program which will culminate in the desired equipment standards. A small amount of effort was put into this project in FY-1972 to compile data on digital equipment presently being offered to the police community.

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Report on Digital Communications Equipment	Continuing	March. 73	May 73	July 73	Sept. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Repeaters

SCOPE

This project is concerned with the transmitters and receivers used in repeaters and their associated hardware.

BACKGROUND

In an effort to bring responsive communications to policemen no matter where they are located, many jurisdictions utilize repeater stations or equipment. Some of the stations consist of a transmitter isolated from a receiver using two separate frequencies. A few use a transmitter and a receiver on the same frequency. Some urban jurisdictions employ receiver repeaters and a voice quality selection comparator known as a voting system to attempt to insure rapid, clear transmissions from all participants, particularly those utilizing low power transmitters. Rural communities quite often use repeaters to facilitate communications over mountainous or rolling terrain where mobile units may not have line-of-sight to base station locations.

PROPOSED PLAN

Our plan is to continue to investigate the types of repeaters in use at present. Typical areas of investigation include the following:

(1) Repeater receiver desensitization due to r-f leakage from the transmitter.

(2) Electromagnetic compatibility of antennas, receivers and transmitters at remote base and repeater sites.

(3) Distortion of audio signals on the hard wire between the dispatching equipment and the remote base equipment.

(4) Selective signaling problems.

Upon completion of this investigation and, as a logical follow on to the standardization of antennas, transmitters and receivers, we will develop and publish standards for the various types of repeaters used by the law enforcement community.

OBJECTIVES

Our FY-1973 objectives are to continue the investigation which should identify the major problems in this area and recommend solutions when possible. A listing of these problem areas with proposed solutions will be included in a project report prepared according to the attached schedule.

LEVEL OF EFFORT

During FY-1973 $10,000 will be expended on this project. This work will be accomplished by the NBS Electromagnetics Division.

REMARKS

$5000 was spent to initiate this project during FY-1972.

REPEATERS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Report on Repeater Systems (10K program)	Continuing	Jan. 73	March 73	June 73	July 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Component Standardization

SCOPE

The items of equipment involved in this project are components of base stations and transceivers such as cables, control heads and microphones.

BACKGROUND

Lack of standardization was cited as a deficiency in the law enforcement communication equipment selection and procurement process by the President's Crime Commission. The Commission specifically referred to those items in a typical police car such as mounting brackets, connectors, microphones and switches. An initial review of the accessory communications equipment being marketed today substantiates this claim. One manufacturer's equipment will not ordinarily interface with another's from either the physical or electrical point of view. This situation often forces the law enforcement agency to purchase new accessory equipment each time a new transceiver is bought. Occasionally equipment made by the same company but during different model years will not physically mate with each other. This problem provides the rationale for pursuing component standardization for communications equipment. Any standards developed may have to incorporate a grace period to allow manufacturers to retool without prohibitive production costs which would be passed on to the user.

PROPOSED PLAN

Our approach will be to review and categorize the accessory equipment on the market. Initially, we will work with cables, connectors, microphones and control heads. In addition to physical and electrical connectors, we will examine control head functions and switch positions and functions. As areas of gain or benefit become apparent, they will be pursued further.

OBJECTIVES

As a minimum, the FY-1973 effort should provide us with the information needed to determine which specific component areas should be standardized. If additional funding is made available, this project will be accelerated and performance standards will be developed for some functions and for components such as cables, connectors and switch locations. The milestones for this project, dependent upon the funding level, are listed on the attached sheet.

LEVEL OF EFFORT

$10,000 will be the minimum provided for this project during FY-1973. These funds will be used to write the report discussed above. An additional $25,000 has been requested to accelerate this program. If this amount can be made available, component standardization will be initiated during this fiscal year. If not, the major effort in this area will be accomplished in FY-1974.

COMPONENT STANDARDIZATION

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Report on Component Standardization (10K program)	Oct. 72	Feb. 73	April 73	July 73	Aug. 73
Components Standard (35K program)	Oct. 73	March 73	Aug. 73	Oct. 73	March 74

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Communications Helmets Standards

SCOPE

This project is being established to standardize the performance requirements of those equipment components needed to facilitate voice communications using the typical police protective headgear. The components involved are the microphone, speaker, and associated connectors, transducers and amplifiers.

BACKGROUND

In order to improve voice communication when wearing protective headgear, NILECJ initiated a project at the Land Warfare Laboratories for testing available headgear and communications equipment to determine their ability to function together. The microphone was of the bone conduction type to allow transmission and reception by policemen without the use of hands. These components were further connected through the use of a special connector, to a typical handheld transceiver which had been modified for this special purpose. This initial testing had been completed successfully, and the use of these components has proven to be of value. The standardization of the performance requirements of the communications components and the dissemination of these standards to the law enforcement community would be appropriate.

PROPOSED PLAN

LESL proposes to test those components used by the Land Warfare Laboratories, plus any others on the market today, to determine their electrical characteristics which in turn will determine their ability to transmit voice communications in a realistic, reliable manner in a high noise environment. If the components perform in a satisfactory fashion, these test results will be used as a basis for the performance standard. Some equipment, such as a modified transceiver, will be available from LWL, while other items will have to be purchased or obtained on loan from manufacturers. Additionally, these components will be tested with the protective headgear in a typical vibration

and shock environment as part of the headgear testing program. Four sets of communications equipment components will be provided by NILECJ for this testing phase.

OBJECTIVES

The objective of this project is to produce a standard describing the performance requirements needed for the components used in standardized police headgear to insure satisfactory operation in a high noise environment. Assuming the availability of the modified transceiver and the four sets of components, this standard will be developed in accordance with the schedule on the attached chart.

LEVEL OF EFFORT

The development of this standard is estimated to cost $30,000. The work will be done by the NBS Electromagnetics Division.

COMMUNICATIONS HELMETS STANDARDS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Helmet Communications Equipment	Nov. 72	Dec. 72	March 73	May 73	Oct. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for
Law Enforcement Communications Terms and Definitions Standard

SCOPE

This task is to establish a list of standard terms and definitions used in the field of law enforcement communications.

BACKGROUND

Many terms which are used in the field of communications have different meanings to different people. To avoid costly misunderstandings between law enforcement agencies, users and suppliers of communications equipment, standard definitions of key terms are necessary.

An initial NBS effort toward standardizing terms used in law enforcement communications included a compilation of terms and definitions previously adopted by several standardizing organizations. This effort resulted in the publication of the following report:

"Technical Terms and Definitions Used with Law Enforcement Communications Equipment (Radio Antennas, Transmitters and Receivers," NBS Report 10 714).

PROPOSED PLAN

The above mentioned report serves as an informational type document and covers only those terms and definitions currently in use by the telecommunications community. This proposed follow on effort is aimed at generating standard terms and definitions recommended specifically for use in law enforcement communications. New terms and definitions will be generated if necessary.

OBJECTIVES

The objective of this effort is to establish a set of standard terms and definitions for use by the law enforcement communications community. The attached table shows the projected milestones.

LEVEL OF EFFORT

Work on this project will be accomplished by the NBS Electromagnetics Division in Boulder, Colorado. The level of funding is estimated to be $25,000.

LAW ENFORCEMENT COMMUNICATIONS TERMS AND DEFINITIONS STANDARD

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Communications Terms and Definitions Standard	Sept. 72	Oct. 72	Nov. 72	March 73	Aug. 73

*Milestone 1 — Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 — Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 — Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 — Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for NILECJ Transceiver Evaluation

SCOPE

This project includes the test and evaluation of the two NILECJ personal VHF/UHF transceivers designed specifically for law enforcement use. Upon completion of this evaluation, the data obtained will be used to update the existing personal transceiver performance standards.

BACKGROUND

The National Institute of Law Enforcement and Criminal Justice has awarded contracts to two industrial concerns to develop and build a personal transceiver for use by law enforcement personnel. These transceivers are being built to specifications provided by NILECJ, and should incorporate many features that are superior to those of personal transceivers on the market today. These transceivers should be tested to insure attainment of the desired performance, and these test results should be used as a basis for changes in the performance standards being developed and written by this laboratory. Therein lies the rationale for the initiation of this project.

PROPOSED PLAN

Upon receipt, the personal VHF/UHF transceivers will be tested in accordance with the specifications of RFP 33657-71-R-0189 to determine performance quality. Measurements will be made in two frequency bands, 150 MHz and 450 MHz. Typically such measurements will include spurious response attenuation, quieting sensitivity, acoustic sound pressure level, frequency stability, among others. Tests will include both transmit and receive modes and will be conducted in two parts: (a) laboratory performance tests and (b) environmental performance tests.

The laboratory performance tests will include an evaluation of the transceiver at normal temperatures, pressures, and humidity. The environmental tests include testing over a selected range of temperatures, pressures, and humidities as well as shock and vibration. Particular attention will be paid to characteristics such as low temperature frequency stability, battery thermal capability and other specifications which will be hard to meet in these small, lightweight personal radios designed for use in a high noise environment without the use of hands.

When the test and evaluation phase is completed, the test results will be used to revise the personal transceiver performance standards to reflect the performance attained by these new transceivers.

OBJECTIVES

This project has a dual objective. The initial objective is to test and evaluate the personal VHF/UHF transceivers designed and built to NILECJ specifications to meet law enforcement communications requirements. The results of this test and evaluation will be used to revise the performance standard for personal transceivers used by law enforcement agencies, which is the second objective of this project. The attached table shows the projected milestones.

LEVEL OF EFFORT

Work on this project will be accomplished by the NBS Electromagnetics Division in Boulder, Colorado. The level of funding is estimated to be $75,000.

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Report of the Test, and Evaluation of the NILECJ Transceiver	Oct. 72	Nov. 72	Feb. 73	April 73	May 73
Revised Handheld Transceiver Standards	Oct. 72	Nov. 72	Feb. 73	May 73	Sept. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall J. Treado, Program Manager
Communications Systems

Project Plan for Communications Equipment Used in Undercover Operations

SCOPE

The items of equipment involved in this project are the transmitters, receivers, recorders, transcribers and other associated equipment used in undercover operations.

BACKGROUND

The tremendous advances in transportation and communications in the past decade have given criminals the capability of fast movement of people and products and almost instantaneous contact with confederates in any part of the country and most of the rest of the world. Technological improvements in communications equipment have produced items that are capable of handling large amounts of information in a more secure manner, using miniaturized equipment that is more reliable and less costly. In order to counter certain of these criminal activities, law enforcement agencies must engage in undercover operations, placing police officers as members of suspected organizations or on special patrol or stakeout duty. Often these individuals must not be in uniform nor carry noticeable or identifiable radio equipment. This illustrates the need for miniature transmitters, recorders, and other associated equipment used in this type of operation. The project described herein is being established to develop those standards needed by law enforcement agencies to assist them in their selection and procurement of communications equipment used in undercover operations.

PROPOSED PLAN

Our plan is to examine the items of equipment now on the market which are being used in undercover operations. We will determine their effectiveness in the transmission of voice communications, their ability to transmit without revealing the individual's location, their range of operation, ease of employment, susceptibility to interference and the overall effectiveness of their use in covert operations. Most of this information will be obtained through testing, either in the laboratory or at a field test site. Test results of this phase will be used to write a report which will include recommendations for the performance criteria requiring standardization. If these recommendations are approved by NILECJ, we will enter phase 2 of this project, which will culminate in the necessary performance standards.

OBJECTIVES

The final objective of this project is to provide the necessary performance standards for undercover communications equipment which will give maximum performance at minimum risk of detection to the user. The first phase of this effort will cover the testing of equipment already on the market and the determination of the functions requiring standardization. This phase will produce a report on the test and evaluation of these items of equipment and will include recommendations as to further work on this project. The projected milestones are shown on the attached table.

LEVEL OF EFFORT

This effort is estimated to cost $45,000. The NBS Electromagnetics Division will do the testing and write the required report.

COMMUNICATIONS EQUIPMENT USED IN UNDERCOVER OPERATIONS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Report of Test and Evaluation of Communications Equipment Used in Undercover Operations	Nov. 72	Jan. 73	July 73	Sept. 73	Oct. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the

Marshall Isler, Program Manager
Security Systems

Project Plan for
Automatic Intrusion Detection Sensors

SCOPE

Automatic intrusion detection sensors are defined as sensors used in an intrusion alarm system designed to detect a specific stimulus generated by an intruder into a protected site. This project does not cover a total alarm system, but only the sensor component. Those devices may be designed to detect energies radiated from an individual, e.g., infrared and motion detection; noises and vibrations characteristic of a physical attack; or to detect the opening of accesss, e.g., door and window switches and window foil. They may be used with a local alarm (bell on the premise), proprietary system, central station service, or linked directly to police station alarm panel.

BACKGROUND

Intrusion alarm systems provide a useful tool for law enforcement agencies in apprehending burglars. Such systems may provide an immediate direct alarm indication in a police station or indirectly through a commercial central station. Because of their increased popularity, increased frequency of false alarms are causing a significant waste of police resources. The false alarm rate is generally 90 to 95% throughout the country as determined by several studies (Crime Against Small Business--SBA, False Alarm Study by the Alarm Industry Committee for Combating Crime, Cedar Rapids Report on Test and Evaluation of Burglar Alarms) and direct contact with several police departments (District of Columbia, Montgomery County, Md., Boston, Mass., and others). The causes of these false alarms run the gamut between procedure or operator error to system (equipment) performance. The sensor is the weakest link in the system performance; therefore, the objective of this project is to develop a family of standards for each category of sensors, primarily addressing the false alarm susceptibility of the device without compromising detectability. Such standards can then be used by local municipalities for regulating the quality of alarm systems in their jurisdiction, when such quality affects their police resources.

There are standards in this area produced by the Underwriters' Laboratories, General Services Administration, Department of Defense, and the Atomic Energy Commission. Generally these standards are concerned only with safety, hardware reliability, and detectability, and are generally designed for a particular environment. Secondly, these standards do not provide the quantitative performance test methods required of a NILECJ standard. However, an attempt will be made to utilize the data in, and where possible, not to conflict with these existing standards.

PROPOSED PLAN

In general, the approach will consist of (1) collecting existing standards and specifications, (2) evaluating existing standards, (3) converting existing standards to a LESL Recommended Standard, if deemed appropriate, or (4) developing new performance levels and test methods through research. For this particular program, it appears that each standard developed will require some research. This will consist of identifying performance characteristics, establishing minimum performance levels, and designing test methods and procedures for measuring performance for the sensor being addressed. The pertinent characteristics will be determined from manufacturers' specifications, requirements of user environment, and laboratory tests. Minimum performance levels will be based on the state-of-the-art as determined by evaluation of sample equipment covering the performance spectrum of manufacturers, on costs, and on user environment. Test methods and procedures will be developed in the laboratory based on, as much as possible, standard engineering measurement practices and test equipment. All work on this project will be implemented as an in-house effort at NBS.

As previously mentioned, there is a myriad of sensors available on the market that sense many different phenomena associated with an intruder. Any combination may be used to design an array to protect a particular site depending upon the nature of the item being protected and the operating environment. Since the optimum array will be unique for a given environment, and since the environment cannot be standardized, the approach will be to develop a performance standard for each category of sensor which will include a characterization of those environments which tend to degrade performance.

The types of sensors to be addressed have been categorized as: (1) electromechanical, which includes magnetic and mechanical switches for doors and windows, foil for windows, protective wiring, and manual hold-up switches; (2) vibration detectors; (3) audio detectors; (4) heat detectors for safes; (5) photoelectric devices; (6) capacitance devices which detect the proximity of a human; and (7) motion detection devices which detect motion of a human by the doppler shift technique. For each of these sensors a standard will be developed that will establish minimum performance levels and test procedures for the following performance characteristics:

1. sensitivity range
2. sensitivity stability
3. false alarm modes and sensitivity
4. hardware failure detection
5. tamper detection
6. reliability

During the development of each sensor standard, LESL will maintain close liaison with industry, the Underwriters' Laboratory, and government laboratories working in this area. An Industry Review Committee has been established to assist in the review phase of the standards development process. This committee represents the National Burglar and Fire Alarm Association, the Security Equipment Industry Association, and the Alarm Industry for Combating Crime. Also included in this review phase is a segment of users--government agencies, American Bankers Association, the Jewelers Alliance Association, and a major insurance company. In addition to these contacts, the Program Manager will monitor related NILECJ burglary projects.

ANTICIPATED TECHNICAL PROBLEMS

During the two years covered by this plan, the project will develop standards for four sensors in the electromechanical category (magnetic switches, mechanical switches, window foil, hold-up devices), two types of vibration sensors, and audio sensors. The anticipated technical problems are a function of the nature of the stimulus detected by the particular sensor. The following is a general description of some of these technical considerations.

The false alarm susceptibility of electromechanical switches is generally a function of the degradation of the electromechanical characteristics due to usage and environmental exposure. In addition, magnetic switches provide balanced magnetic and/or electrical circuitry to protect the sensor from certain attempts to tamper and defeat. These protection schemes can increase the susceptibility to false alarms. Therefore, the technical objectives are to define the false alarm modes due to endurance limitations and protective circuitry, and to establish minimal quantitative acceptable false alarm resistance based on the equipment limitations without compromising its detectability.

Window foil consists of thin strips of current carrying foil that are attached to glass in order to detect breakage. The false alarm susceptibility in this case is a function of deterioration of the material due to the operating environment, e.g., temperature changes, humidity, etc. Therefore the salient problem is defining these environmental characteristics, determining the limitations the material properties, and developing the appropriate test methods.

Hold-up devices are manually operated switches in the form of push buttons, foot-rails, and money-clips. False alarms associated with these devices are generally accidental initiations by the operator. Therefore, the problem to be addressed is of a human engineering design nature--a standard that ensures human engineering considerations to minimize false alarms without compromising the ease of operation in an emergency situation.

Audio and vibration detectors are designed to detect energy levels in a specific spectrum associated with a physical attack. The problem with respect to false alarms is the selection of that spectrum so as not to include normal environmental stimuli, or to provide the necessary discrimination circuitry to separate these environmental stimuli from that of the intruder. The development of the standard must then include the defintion of the environmental stimuli and that of the intruder, establish discrimination performance levels, and provide tests to measure the discrimination capability of the equipment.

OBJECTIVES

The following standards will be completed during FY-73.

Standard for Magnetic Switches
Standard for Contact Vibration Sensors
Standard for Mechanical Switches
Standard for Mercury Switches
Standard for Window Foil.

Work on the development of the following standards will be started, but not completed, during FY-73.

Standard for Audio Sensors
Standard for Microphone Vibration Sensors
Standard for Hold-up Devices.

The projected milestones are given in the attached table.

LEVEL OF EFFORT

	FY-72	FY-73	Total
Magnetic Switch Standard	$44,000	--	$44,000
Contact Vibration Sensor Standard	20,000	--	20,000
Mechanical and Mercury Switch Standards	19,500	10,300	29,800
Window Foil Standard	4,000	16,400	20,400
Audio Sensor Standard	9,000	26,200	35,200
Microphone Vibration Sensor Std.	--	12,000	12,000
Hold-up Devices	--	5,100	5,100
	$96,500	$70,000	$166,500

AUTOMATIC INTRUSION DETECTION SENSORS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Magnetic Switches	Continued	Completed	Completed	Completed	July 72
Standard for Contact Vibration Sensors	Continued	Completed	Completed	July 72	Oct. 72
Standard for Mechanical Switches	Continued	Completed	Completed	July 72	Oct. 72
Standard for Mercury Switches	Continued	Completed	Completed	Aug. 72	Nov. 72
Standard for Window Foil	July 72	Aug. 72	Nov. 72	Dec. 72	Mar. 73
Standard for Audio Sensors	Aug. 72	Oct. 72	Mar. 73	May 73	Sept. 73
Standard for Microphone Vibration Sensors	Aug. 72	Nov. 72	Apr. 73	May 73	Sept. 73
Standard for Hold up Devices	Mar. 73	June 73	Oct. 73	Nov. 73	Feb. 74
Standard for Ultrasonic Motion Detectors	Dec. 72	Mar. 73	Nov. 73	Dec. 73	Apr. 74
Standard for Microwave Motion Detectors	Dec. 72	Apr. 73	Dec. 73	Jan. 74	May 74

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall Isler, Program Manager
Security Systems

Motion Detection Sensors

This represents an additional task of the project plan for Automatic Intrusion Detection Sensors. The Scope, Background and Proposed Plan described in that plan are directly applicable to this task.

ANTICIPATED TECHNICAL PROBLEMS

The particular motion detection devices considered here are active sensors that radiate and receive energy in the ultrasonic or microwave frequency spectrum and utilize the Doppler principle for detecting motion in the covered area. Although these devices are thought to be the most sophisticated sensors on the commercial market, they represent a major culprit in terms of false alarm susceptibility. The problem is the inability of these devices to discriminate between the stimuli generated by the environment and those generated by the intruder. The development of the standard must therefore include defining these stimuli, establishing discrimination performance levels, and providing tests to measure the discrimination capability of the equipment.

OBJECTIVES

The projected milestones are included in the table attached to the project plan for Intrusion Detection Sensors to which this project is an addendum.

LEVEL OF EFFORT

Motion Detection Sensors $30,000

REMARKS

This task will start mid FY-73 and continue through the third quarter of FY-74. The requested funds cover only that portion to be conducted in FY-73. It is estimated that an additional $30,000 will be required in FY-74 to complete the task.

Marshall Isler, Program Manager
Security Systems

Project Plan for
Portable Night Vision Devices

SCOPE

Portable night vision devices are defined as handheld, self-powered, direct-viewing, optical imaging devices used to enable the viewer to visually discern images at illumination levels normally undiscernable by the naked eye. There are basically two types, passive and active. The passive device consists of three components: an objective lens, an image intensifier, and an eyepiece lens. The objective lens focuses an image of the scene to be viewed onto the input screen of the image intensifier tube. The image intensifier produces an intensified image of the scene on the output screen of the tube. The eyepiece enables the viewer to see the scene on the output screen. The active device employs an infrared illumination source to covertly enhance the illumination level of the scene. Cameras can be used with both the passive and active devices to record the scene image.

BACKGROUND

Night vision technolgoy was developed by the military primarily in response to the operational requirements of Vietnam. In 1969, the military declassified the components used in some devices making them available for law enforcement use. Since that time, at least ten manufacturers have produced and sold these devices to various law enforcement agencies. The price ranges from $400 for an active device with single stage intensification to $7,000 for a passive device with camera and assorted lenses. The quality also varies significantly. Obviously, such devices enhance the capability of law enforcement agencies to conduct covert surveillance under low light level conditions. Presently, standards or procurement guidelines do not exist other than military specifications, which do not address the urban environment or other types of unique law enforcement requirements.

PROPOSED PLAN

Generally, the performance characteristics in terms of image quality are the same for both types of devices; therefore, the approach is to develop the first performance standard on the passive device and then make applicable modifications for a second standard on the active device. A parallel effort will be directed toward ascertaining the image quality requirements necessary to perform the surveillance mission of law enforcement agencies. Therefore, the two major tasks are the development of image quality requirements and the development of the equipment performance standard consistent with those requirements.

The most stringent operational requirement is the ability to identify an individual in a photograph taken through a night vision device. Such is the case when surveillance data are submitted in court as evidence. Similar effort has been done by the military for identifying things, e.g., tanks, aircraft, etc. However, based on literature survey and discussions with leading experts in the field, such quantitative data are not available for identifying people. Therefore, the determination of the required image quality will be accomplished through the experiment described in Attachment 1.

The approach to determining the equipment performance standard, including minimum image quality levels, will generally consist of surveying the technology, determining the pertinent performance characteristics, developing measurement procedures, verifying measurement procedures and ascertaining existing equipment performance through laboratory evaluations, and finally, drafting the standard and conducting a review with industry, users, and other interested parties. The tentative pertinent performance characteristics and measurement approach as of this writing are outlined in Attachments 2 and 3 respectively.

The project is being conducted by the Optical Radiation Section and Applied Acoutics and Illumination Section of NBS. A supporting contract in the area of lens evaluation has been let to the Photographic Engineering Division of the Naval Ordnance Laboratory (NOL), White Oak, Maryland.

OBJECTIVES

Standard for passive night vision equipment
Standard for active night vision equipment
Report on image quality requirements
Report on objective lens test procedure
Report on image quality evaluation
Report on test apparatus and procedures

The projected guidelines are given in the attached table.

LEVEL OF EFFORT	FY-72	FY-73	Total
Equipment Standard:			
Manpower	$42,000	$44,000	$86,000
Test Equipment and Specimens	16,000	6,000	22,000
Image Qualtiy Requirements Study:			
Manpower	21,000	30,000	51,000
Photographic Lab. Support	4,000		4,000
Lens Test Procedures (NOL contract)	18,000	5,000	23,000
	$101,000	$85,000	$186,000

Image Quality Requirements Experiment

The immediate need appears to be a quantitative assessment of the subjective response, image quality, followed by the determination of a physical measure that correlates with this subjective response. There are no standards in existence today to evaluate image quality. Image quality is not a unitary dimension, but is a function of several characteristics: resolution, scale, acutance, contrast and granularity. This leads to the obvious conclusion that no single physical correlate can be found to completedly describee image quality. The most we can hope for, with a single physical measure, is an acceptable correlation with the subjective evaluation of image quality.

The quality of an image can be considered at three levels:

1. Detection--There is an object in the picture,

2. Identification--The object in the picture is a man,

3. Recognition--The man in the picture is John Doe.

This study will be concerned with the third category, recognition. Is there a physical measure that gives a satisfactory correlation with the subjective estimate of image sharpness?

Approach: Additional literature survey and personal discussions with researchers in image evaluation will be conducted. The tentative experimental design would involve having the subjects make paired comparisons of photographs made from the same orignial, but take at different distance from the focal plan. This will give a series of pictures made from the same scene, differing only in blurriness. Photographs of a knife edge will be taken simultaneously with the photograph of the original scene. The knife edge photographs taken under different conditions of defocus will be microreflectometered. Modulation transfer functions and acutance measures will be derived from the edge gradient analysis of the knife edge. The psychophysically determined scaling of image quality will be compared with the derived physical measures. The study will initially concentrate on obtaining extensive data from a few subjects in order to determine the best physical correlate followed by validation studies involving a large population to obtain statistical measures of image quality assessment.

An experiment on contrast reduction will be performed in conjunction with the sharpness evaluation study. The same original pictures will be systematically reduced in contrast by superpositioning a veiling light over the whole scene by a beam splitter. Scaling functions will be obtained from paired comparisons of these amplitude modulated images and correlations with physical measures will be determined.

Performance Characteristics of Night Vision Devices

1. Dark current. This is the spurious signal produced when there is no light input and can be measured as the luminance of the output screen when the input screen is blocked.

2. Optical gain. This can be expressed as the ratio of the luminance of the output screen for unit irradiance on the photocathode. Since the spectral sensitivity of the photocathode is different from that of the eye, and includes some wavelengths in the ultraviolet and infrared, the irradiance cannot properly be evaluated in photometric units. The optical gain will vary with the ambient light level and should be evaluated at several levels of illumination.

3. Optical resolution. The optical resolution of a system is best expressed as the modulation transfer function (MTF) of the system. However, MTF theory is based on the assumption that the optical gain of the system is linear and that stationarity exists between objects in object space and image space. Neither of these conditions is completely satisfied by image intensifier devices. In addition, equipment for evaluating MTF of image intensifier devices is very expensive to procure and operate. Adequate information may be obtained by use of standard resolution charts at perhaps three degrees of contrast, or by contrast transfer function measurements.

4. Tone reproduction. The number of gray scale steps that can be distinguished in a scene is an important part of the information content. The gray scale steps that can be distinguished at different levels of illumination should be determined.

5. Light-generated noise.The dark current of many image intensifier tubes is strongly influenced by the light striking adjacent parts of the photocathode. This may be due to light scatter or other imperfections on the outer surface of the objective lens by internal reflections between the elements of the objective lens, by light reflected by the inner surface of the barrel in which the lens is mounted, or by light from the phosphor screen passing back through the tube to the backside of the photocathode where it generates spurious electrons. This effect can be evaluated by viewing a small black spot in the center of an illuminated field. The ratio of the brightness

of the image of the black spot to that of the surrounding field in the image is a measure of the light generated noise and should be evaluated for several levels of field brightness.

6. Mechanical ruggedness. Some of the night vision devices may be used as rifle sights. Others will undoubtedly be subjected to mechanical abuse in normal use. Some type of controlled mechanical shock, perhaps followed by total immersion in water, probably should be included in the test schedule. Such treatment should be followed by a repeat of at least the dark current and optical gain tests to evaluate the effect of the treatment on performance of the device.

Proposed Test Procedures for Night Vision Devices

The test methods to be used in evaluating night vision devices are subject to several constraints. In general test methods are desired that a) accurately evaluate the performance characteristics of the tested device, b) to the extent possible require only such test equipment as is readily available in a well-equipped laboratory, and c) can be performed by a capable laboratory assistant and should not require extensive education or training on the part of the operator.

1. Spectral Optical Gain. Measurement of spectral optical gain is quite simple conceptually, but rather difficult experimentally. What is required is that the input surface of the device be irradiated in a uniform manner with monochromatic radiant energy of known wavelength and spectral distribution, and luminance of the output screen be measured. The major difficulty arises because the measurement involves the evaluation of a ratio of two different kinds of radiant quantities, both of which have low values. The luminance of the output screen can be measured easily with a photometer. The absolute irradiance on the input surface is much more difficult to measure for at least two reasons. First, the absolute value of the irradiance will be very low, and second, no suitable detector is currently available for measuring it. Available detectors that are essentially free from variations in spectral sensitivity, and hence are suitable for comparing the absolute radiance or intensity of beams of different spectral composition, are thermal detectors and have low overall sensitivity. However, pyroelectric detectors now under development show promise of having the needed combination of flat response and hight sensitivity.

The experimental arrangement for measuring the spectral optical gain will consist of a prism monochromator with a tungsten filiment source to provide the monochromatic incident radiant energy. The output beam from the monochromator will be directed into a small averaging sphere having two detector ports. A pyroelectric detector will view the sphere wall through one port, and the device under test will view the sphere wall through the second port. In this way incident radiant energy of any desired wavelength, bandpass, and absolute level can be provided. Neutral density filters, or an iris diaphragm between the monochromator and the averaging sphere, can be used to vary the amount of radiant energy reaching the averaging sphere.

2. Total Optical Gain. Measurement of total optical gain, the ratio of the luminous output of the phosphor screen of the instrument under test to the irradiance on the input surface from a source having the spectral distribution of C.I.E. illuminant A, presents no serious problems. A large integrating sphere will be used as the source. Light input to the large integrating sphere will be from a smaller integrating sphere attached to it through a large iris diaphragm. Light input to the small integrating sphere will be from 45 watt quartz-halogen lamps, whose color temperature can be varied by varying the input voltage to them.

The luminance of the wall of the large sphere can be measured with the same instrument used to measure the output of the phosphor screen. Since the spectral distribution of the light in the large sphere remains constant and is known, the measured luminance can be converted to radiance if desired, or the results can be reported as the ratio of luminance of the output screen per unit illuminance of the input surface from C.I.E. source A.

Total optical gain will be evaluated at several levels of input irradiation from levels corresponding to about the equivalent of starlight on a moonless night to about twice the level of full moonlight on a clear night.

3. Dark Current. The dark current will be measured with the same equipment used to evaluate total optical gain. A lens cap will be placed over the objective lens of the device and the luminance of the output screen will be measured. The lens cap will then be removed and the light in the large sphere will be adjusted until the output of the phosphor screen is just twice what it was with the lens cap on. The luminance of the sphere wall will then be measured and the dark current will be reported as this luminance value. As an alternative, the dark current may be computed from the observed luminance of the phosphor screen and the optical gain of the instrument at low light levels.

4. Light-generated Noise. Light induced background will be measured with the same equipment used for the total optical gain measurement, but in this case the large integrating sphere will have a hole in its wall opposite the viewing aperture. This hole will be of such a size to subtend a conical solid angle having a plane half angle of 0.5°, and will have blackbody cavity behind it.

The night vision device will be set up so that its objective lens is just inside the viewing aperture, so that its outer surface is irradiated uniformly by the light from the shpere, and focused on the black hole in the opposite wall of the sphere.

The luminance of the output screen will be measured at the center of the image of the black spot and at four points in the bright area surrounding the image of the black spot. Measurements will be repeated at several levels of luminance in the sphere. The light induced background will be reported as the ratio of the luminance of the image of the black spot to that of the area surrounding it as a function of the luminance in the sphere.

5. Optical Resolution. The limiting resolution will be evaluated by means of a standard resolution chart in the form of a transparency, mounted in the viewing aperture in the integrating sphere and illuminated diffusely by light from the sphere. The chart will be viewed from a distance of 25 times the focal lensth of the objective lens on the device. The objective lens will be carefully focused to give maximum resolution, the eyepiece lens will be carefully focused to give sharp image of the phosphor screen. The resolution will then be evaluated visually as the size of the pattern with the highest spatial frequency (smallest lines) that can be clearly identified as lines, in terms of the line pairs per millimeter on the input surface of the instrument. Measurements will be made with charts of several degrees of contrast and at several levels of luminance at each degree of contrast.

6. Contrast Transfer Function (Tone Reproduction). Contrast transfer function will be measured with the same equipment used for the resolution measurements. In this case, a Pritchard Model 1980 Photometer or equivalent with a microscope objective and an aperture that views an area on the phosphor screen that is approximately 10 x 50μm in size, mounted on a motor-driven scanning device, will be used to scan across the image of the different resolution patterns. The contrast ratio for each pattern will be computed as the ratio of the minimum luminance when viewing a black line to the maximum luminance when viewing the space between the lines, divided by the same ratio obtained in direct measurements on the resolution pattern itself. The contrast ratio so obtained will be plotted as a function of spatial frequency to obtain the contrast transfer function curve for a given level of luminance on the pattern. Curves will be obtained for several levels of luminance.

7. Flare. Flare will be observed by viewing a dark area in the Photometry Tunnel, with a light bulb of known luminous intensity shielded from the dark area being viewed by the instrument, just outside the field of view of the instrument. A photograph will be taken of the resulting pattern to serve as an indiction of the flare.

8. Distortion. Distortion produced by the instrument will be measured by taking a photograph of a grid pattern with the instrument under test. An enlarged print of the image will then be compared to a distortion-free image of the same grid pattern of the same size, and the distortion will be evaluated as the maximum deviation between the two patterns, expressed as a percentage of the distance from the center of the pattern. The distortion will be classified as pincushion type or barrel type.

PORTABLE NIGHT VISION DEVICES

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Std. for Passive Night Vision Equipment	Continuing	Completed	Oct. 72	Dec. 72	Apr. 73
Std. for Active Night Vision Equipment	Continuing	Completed	Dec. 72	Mar. 73	Jun. 73
Image Quality Requirements Experiment	Continuing	Completed	Oct. 72	Dec. 72	Mar. 73
Objective Lens Test Procedure	Continuing	Completed	Aug. 72	Sept. 72	--
Report on Image Quality Evaluation	Continuing	Completed	Completed	Completed	July 72
Report on Test Apparatus and Procedures	Continuing	Completed	--	Aug. 72	Sept. 72

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall Isler, Program Manager
Security Systems

Project Plan for
Closed Circuit Television Systems and Video Tape Recorders

SCOPE

Closed circuit television (CCTV) systems provide the capability for real-time remote viewing and remote recording of an image of interest, or recording that image at the scene for later reproduction analogous to a movie camera. A basic system is composed of a television camera with associated electronics, communications link, and monitor for viewing the the image. In addition, a video tape recorder (VTR) is generally used as a part of the system for recording purposes. Television cameras are designed for either/or combination of daylight, artificial light, or low light level illumination conditions, and may have a capability for color as well as black and white reproduction. Cameras range in size from handheld portable units to semi-permanent studio cameras. The communication link may be cable or RF. The monitor is generally a standard TV receiver with appropriate modifications for interfacing with the communication link. Depending on the application, the video tape recorder varies in features and size.

BACKGROUND

The two primary applications of CCTV to law enforcement are in the area of surveillance and training. Fixed or semi-portable CCTV can be used for traffic control, remote command and control in civil disturbance situations, remote stakeouts, and for security surveillance in and around law enforcement facilities and penal institutions. VTR's can be used for gathering evidence during a disturbance or at the scene of a crime or accident, and for recording suspects for police line-ups. CCTV and VTR's also can be used for recording lectures and presenting practical problems.

The decision to pursue this project was based on the aforementioned apparent utility of CCTV to law enforcement agencies and the desire to exploit the test equipment and experience gained in developing the performance standard for portable night vision equipment. The image quality requirements developed for the night vision equipment and some of the test equipment and procedures will have direct application to this project.

PROPOSED PLAN

The first item to be addressed will be the portable, black and white, video tape recorder (VTR) and associated playback monitor. This combination was chosen because its relative cost and flexibility put it within the reach of most police departments as opposed to studio type and fixed CCTV systems. Therefore, there should be a broad potential use of the standards and procurement guidelines. Secondly, the experience gained will have direct application to all CCTV systems that may be studied in the future, since the technology is essentially tne same.

The specific output and approach will be based on the user requirements data as obtained in the NILECJ sponsored TAD Law Enforcement Equipment Survey, and an evaluation of existing standards on this type of equipment. If these data indicate that police departments do not have equipment performance or interface problems, and if existing standards appear to be adequate, then the direction of this effort will be toward a selection and application guideline instead of standards. Such a guideline would relate the technical and operational features of a VTR to the needs of the user, thus providing him the technical rationale required to select the most effective features for his particular application. Therefore, the first phase of this project will be the determination of the most appropriate type of output and the development of the specific approach. Upon completion of this phase, a revised project plan will be submitted reflecting the selected approach.

In general, the performance and design characteristics that presently appear important in any CCTV system are image reproduction quality, electromechanical interface, and ruggedness. The final reproduction quality requirements on the output monitor will be similar to the detection, recognition, and identification levels developed by the image quality requirements study under the night vision equipment project. The reproduction performance of a CCTV system is primarily a function of the noise or degredation contribution of each component, e.g., optics, camera electronics, communcations link, monitor, VTR, and tape. Interchangeability of components should be accomplished without suffering a system degredation below an established level. Therefore, the development of minimum performance levels as required in a standard must address the performance of each component with respect to the minimum

system levels. The electromechanical interface must also be addressed if interchangeability is required. Ruggedness covers degraded performance experienced under certain environmental conditions. Environmental tests must be designed to reflect the intended operational use. The selection of the actual characteristics and degree to which it will be addressed will result from the phase one work.

This project will be implemented within NBS.

OBJECTIVES

See Remarks below. The projected milestones are given in the attached table.

LEVEL OF EFFORT

	FY-73
Manpower	$20,000

REMARKS

Since the same group is involved and funding constraints limit the total resources which can be applied in FY-73, the project will not formally begin until completion of the standards for night vision devices. However, the program manager has initiated contact with industry and is collecting brochures and existing standards and specifications. It should be noted that the funding covers only the first phase of the project as previously described. Upon completion of this phase and determining the specific direction of the project, additional funding requirements can be estimated.

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Std./Procurement Guide Video Tape Recorders	Jan. 73	June 73	+	+	+

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

+ These dates will be determined upon completion of Milestone #1.

Marshall Isler, Program Manager
Security Systems

Project Plan for Physical Security Systems for Doors and Windows

SCOPE

The purpose of this project is to develop security performance standards and component selection guides for door and window systems, and an associated glossary of terms and definitions. The standards will define minimum performance levels for a given threat level, and test procedures for measuring performance. The standard will address each component of the system, since the integrity of the system is no greater than its weakest link. For an example, when addressing a door system, the standard must consider the type of door (material, construction, operation, etc.), the frame construction, the hinges, and the locking device.

It is presently perceived that two standards will be developed--one for doors and another for windows. Each standard will define performance criteria for each type of system and generic type of component against a defined threat, and a test procedure for rating the type. The selection guides will present evaluation data in a manner to allow the user to select a mix of components to meet a selected threat level. This ability of the user to select components to meet his particular threat level is critical to flexibility and utility of the standards, since the threat level and resources of the user will vary considerably. Some of the potential users or application of the standards include: single home, multiple dwellings, small businesses, large businesses, financial institutions, public buildings, city ordinances, building codes, Federal agencies (HUD, FIA), and insurance companies.

BACKGROUND

The number of reported incidents of burglary in 1970 as reported in the 1970 Uniform Crime Report was 2,169,300--an increase of 11% over 1969. The associated losses totaled $672 million, of which $494 million were from residences and $168 million were from commercial establishments. Seventy percent of the commercial losses were borne by small business as defined by the Small Business Administration.

These statistics illustrate the magnitude of the burglary problem, and the fact that the major burden of the losses, 84%, are borne by residences and small businesses. Two of the reasons why these establishments are vulnerable are: (1) home owners and small businessmen do not have the technical expertise to optimize their security to meet the anticipated threat, and (2) building codes do not specify security requirements, therefore, the original security fixtures of the structure may be inadequate. The proposed LESL effort, if successful, will provide a means to correct these deficiencies, and thereby decrease burglary vulnerability.

The Underwriters' Laboratories (UL) 1969 field service record on "Certificated Burglar Alarms" indicated that of the 3322 reported attacks on establishments with UL certified burglar alarms, 92% were against doors and windows. This provides an obvious indication that doors and windows are prime entry points and should represent the first line of defense for deterring and preventing entry. Therefore, doors, windows and other structural openings such as skylights are chosen as the items to be addressed in this project.

PROPOSED PLAN

The following tasks will be conducted in the development of the standards, guides and glossary. The development of the standard for windows and the standard for doors will be a parallel effort. The attached flow chart illustrates the relationship among the tasks.

Task 1 Categorize types of door and window systems. For example, a door may be categorized by its operation, i.e., fixed swing, sliding, or rolling, single or split.

Task 2 Categorize components of each type. This would include a delineation of the materials and construction for both door/window and frame, and the hardware (hinges, locks, etc.) associated with each type.

Task 3 Develop test methods. This will consist of selecting the pertinent security performance characteristics of the system type and components, and selecting existing test methods for developing new methods for measuring the characteristics.

Task 4 Define threats. The threats will be determined as a function of the sophistication level of the attacker, the kinds of tools used, and the time to defeat. Some forms of attacks that will be considered are brute force (pressure against the door distributed among all components and glass breaking), tool attacks against the door (drilling and sawing), surreptitious attacks against locks (picking), tool attacks against door knob, attacks against locking bolt (hacksaw, hammer-bar), and attacks against door frame (knifing, wedging). This task will rely heavily on data from two NILECJ studies--An Evaluation of Small business and Residential Alarm Systems being conducted by GTE Sylvania, Inc.; and Burglary Prevention being conducted by the City of Alexandria, Va. In addition, the following NILECJ studies are directly applicable: Burglary, A Study of its Correlates, Correctives and Causes; Crime in and Around Residences; Architectural Design to Improve Security in Urban Residential Areas; and Burglary, A Study of its Character, Correlates and Correctives.

Task 5 Define security levels. A maximum of five levels will be defined that will cover the spectrum of threats defined in Task 4. Again, maximum utilization will be made of existing NILECJ studies.

Task 6 Establish minimum performance levels for each component of the system consistent with the defined security level. For example, the components of a door system could include the door, penetration resistant glass or grills, if used, frame, hinges, and locking device. Minimum performance levels for the system will be established in a manner to allow the user to select combinations of components to meet a particular security level.

Task 7 Perform tests on sample systems and components. These tests will be conducted for the purpose of verifying test methods, determining state-of-the-art with respect to performance of existing equipment, and rating systems generic component types for the selection guides.

Task 8 Prepare the standards for review by NBS and external sources and for submission to NILECJ.

Task 9 Assess risk to typical establishments based on statistical data. This task will assess the burglary risk to typical residential and commercial establishments as a function of type (as defined by the Department of Commerce and several NILECJ studies), location, and burglary patterns. The sources of data that will be used in this task include: the FBI Uniform Crime Report, Crime Against Small Business, UL's Field Service Record of Certificated Burglar Alarms, several books on security, and the previously mentioned NILECJ studies in Task 4.

Task 10 Relate security levels to typical establishments. This task will select the appropriate security level as defined in Task 5 for the typical establishments as a function of the risk defined in Task 9. This will assist the user of the guides in selecting the most appropriate choice of security level for his particular establishment.

Task 11 Prepare security selection guides for doors/windows. The guides will present the recommended security level for typical establishments, and associated matrices of rated systems and generic types of components that can be selected to meet the selected security level.

Task 12 Collect and collate existing terms and definitions. Generally this will consist of a literature search of existing definitions, and adding to or modifying as appropriate.

Task 13 Prepare glossary of terms and definitions. This includes drafting the document, coordinating an NBS external review, modifying as appropriate, and submitting recommended document to NILECJ.

In view of the probable funding constraints suggested for FY-73, it is proposed that this project be conducted in two phases. Phase I, to be conducted in FY-73, will produce an interim standard for doors and an interim standard for windows. Phase II, to be conducted in FY-74, will produce the final standards, the selection guides, and the glossary of terms and definitions.

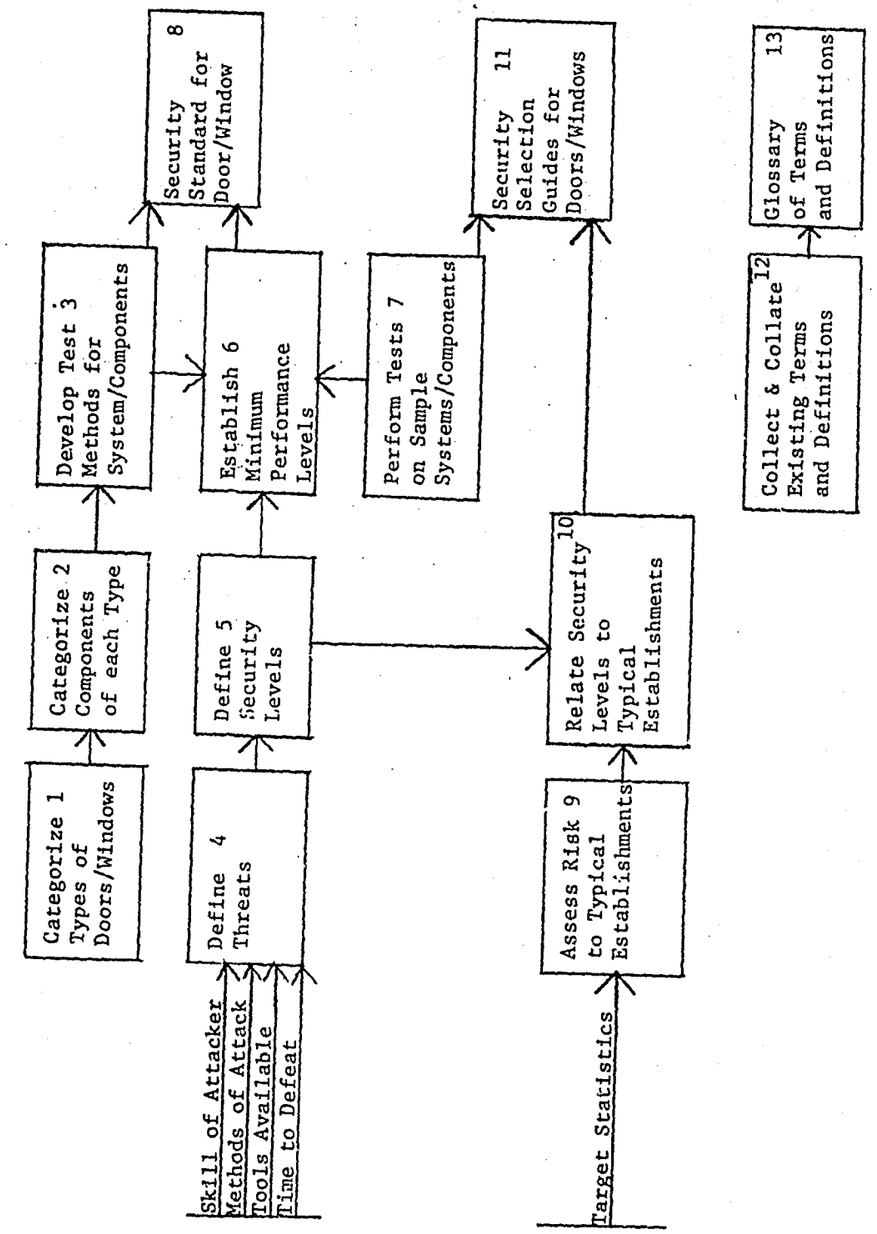
Phase I will consist of selecting only the most commonly used system and components, and processing them through the tasks leading to the interim standard. Test methods will generally be limited to existing methods that are directly applicable or that could be readily modified. Testing will be limited to the minimum required to verify modified test methods and determining performance of the selected systems and components. Systems and components will not be rated.

Phase II will address those remaining systems and components and the development of new test methods as appropriate, leading to a final recommended standard. All tasks leading to the selection guides will be conducted including the rating of systems and components. In addition, the glossary of terms and definitions will be produced.

LEVEL OF EFFORT

Task	Phase I (FY-73)	Phase II (FY-74)
1	$ 7,000	$ 3,000
2	7,000	3,000
3	12,000	23,000
4	7,500	0
5	5,000	0
6	16,500	30,000
7	10,000	51,500
8	5,000	10,000
9	0	10,000
10	0	7,500
11	0	10,000
12	0	3,000
13	0	2,000
	$70,000	$153,000

TASKS TO THE DEVELOPMENT OF PHYSICAL SECURITY STANDARDS FOR DOORS AND WINDOWS



PHYSICAL SECURITY SYSTEMS FOR DOORS AND WINDOWS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Interim Security Performance Standard for Doors	Aug. 72	Oct. 72	Feb. 73	April 73	July 73
Interim Security Performance Standard for Windows	Aug. 72	Oct. 72	Feb. 73	April 73	July 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Marshall Isler, Program Manager
Security Systems

Project Plan for
Police Alarm System Annunciators

SCOPE

The police alarm system annunciator is an indicator and display module used in a police station to receive burglary and holdup alarms from a remote site. Generally, it consists of a set of light indicators from each protected site that displays the status of the system; secure or access mode, and alarm or trouble condition. The initial alarm indication is provided by a bell or buzzer.

BACKGROUND

The rising rate of burglary and holdups and the corresponding demands of insurance companies have significantly increased the popularity of burglary and holdup alarms. In most areas of the country these alarms may be received directly by an annunciator located in the police station. Because of the various secure communications schemes used to transmit the alarm signal, and marketing pressures for new features, each manufacturer of the protected site equipment may require his particular annunciator in the police station. In addition, these annunciators vary significantly in functions and displays due to the absence of a standard design. As a result of the above factors, there exist today a proliferation of different annunciators in police departments with a variety of functions and displays; various sizes, which are incompatible with each other; and various communication schemes and sensor control panels used in the system. The attached photograph illustrates an example of annunciators installed. This situation adversely affects the performance of the police in operating and maintaining such systems, and in many cases may limit the number of annunciators a department can install.

PROPOSED PLAN

The objective of the annunciator project is to develop a design standard for the annunciator panel that will emphasize commonality of displays and functions, modularization of displays to allow an increase of capability through a "building-block" approach, and interchangeability of modules and components among different manufacturers. Since the nature of the annunciator standard is more design than performance oriented, and since the number of manufacturers are relatively few (10-15), the approach used will differ from the normal LESL standardizing process. LESL will establish a committee of manufacturers and users who will from the outset assist in establishing common electrical interfaces, modular sizes, functions, and displays. This committee will also act as the primary source of review for the final draft.

OBJECTIVE

The projected milestones are given in the attached table.

LEVEL OF EFFORT

Police Annunciator Standard	FY-73 -- $40,000

PROPOSED PLAN

The objective of the annunciator project is to develop a design standard for the annunciator panel that will emphasize commonality of displays and functions, modularization of displays to allow an increase of capability through a "building-block" approach, and interchangeabjility of modules and components among different manufacturers. Since the nature of the annunciator standard is more design than performance oriented, and since the number of manufacturers are relatively few (10-15), the approach used will differ from the normal LESL standardizing process. LESL will establish a committee of manufacturers and users who will from the outset assist in establishing common electrical interfaces, modular sizes, functions, and displays. This committee will also act as the primary source of review for the final draft.

OBJECTIVE

The projected milestones are given in the attached table.

LEVEL OF EFFORT

Police Annunciator Standard FY-73 -- $40,000

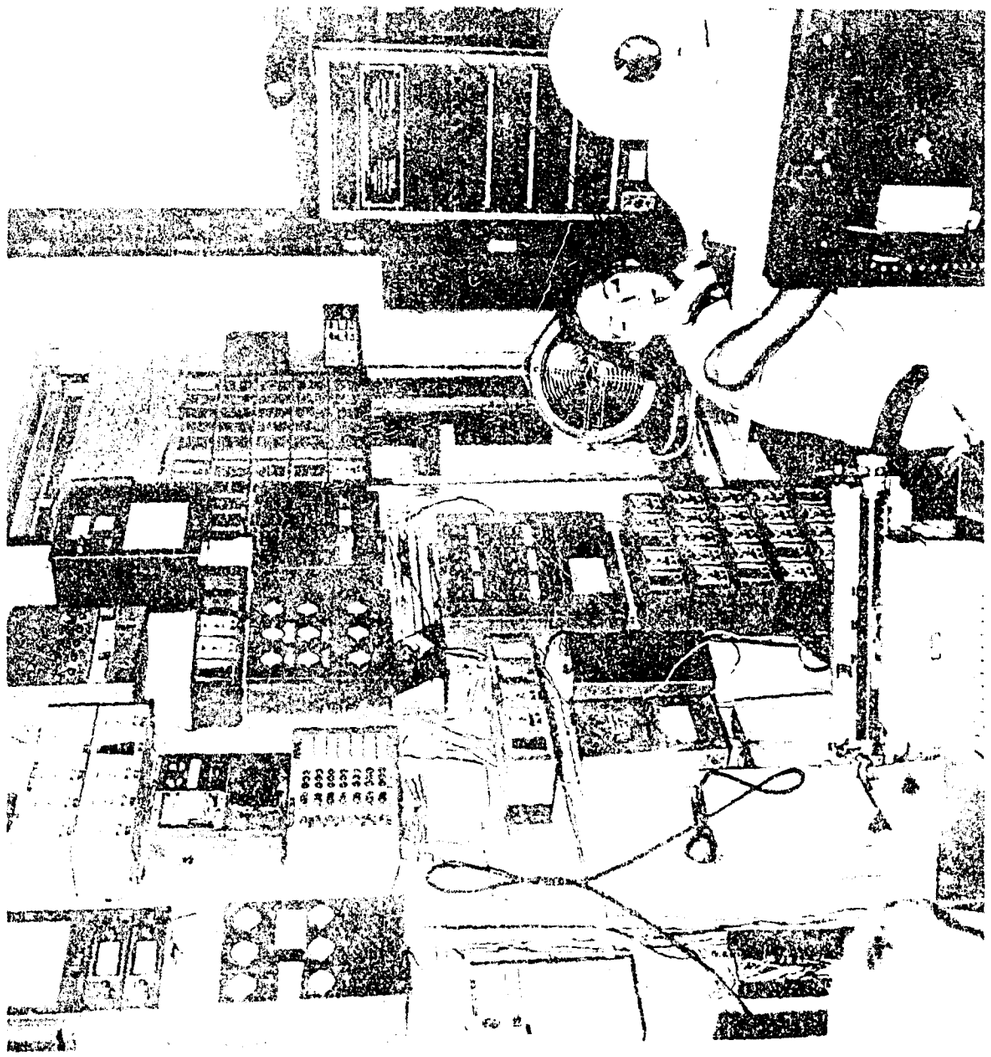
Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Std. for Police Annunciators	Oct. 72	Jan. 73	June 73	July 73	Oc. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.



Marshall Isler, Program Manager
Security Systems

Project Plan for Guides for Police and Security Photography

SCOPE

The purpose of this project is to develop a series of guides for the selection and application of photographic equipment for police and security operations. A Selection and Application Guide for Police Photographic Equipment will relate the various generic types of photographic equipment to police operations in a manner that will allow the purchaser to optimize the utility of selected equipment. A Selection and Application Guide for Fixed Surveillance Cameras will address the selection of various generic types of automatic surveillance cameras for various applications and environments, and will provide installation guidelines for optimizing performance. The third document will be a Glossary of Photographic Terms and Definitions oriented toward police applications.

BACKGROUND

Traditionally, photography was used by police departments only after the fact for collecting evidence at the scene of the crime. The police photographer was part of the investigating team, and the requirements for photographic equipment were limited. Presently, the application of photographic equipment has expanded into the area of surveillance. This has resulted in an increasing demand for different types of and more flexible equipment. In addition, the variety of users of the equipment has expanded to include the patrolman, special "stake out" teams, and the businessman who needs a surveillance system for his establishment. This increasing assortment of applications and users and the availability of new equipment creates a need for guidelines for the selection and application of photographic equipment.

PROPOSED PLAN

The following steps are planned for the development of the Selection and Application Guide for Police Photographic Equipment.

1. Delineate the various applications of photographic equipment to police operations--this would include a description of the types of operations, e.g., surveillance, training, evidence collection, mug photographs, etc., and the associated operational environments. This information will be obtained from various publications and articles on police photography and, to a limited degree, visits to some of the local police departments.

2. Delineate the types of cameras and associated equipment available--this would include a description of the generic types of camera equipment available, e.g., single-lens reflex, range-finder, Polaroid, 4" x 5" format, etc., and the associated lenses and special features. The various types of film will also be included. This information will be obtained from manufacturers.

3. Relate equipment to application--this will provide trade-off rationale for selecting the optimum mix of equipment to meet a single or mix of operational requirements.

The plan for developing the Application Guide for Fixed Surveillance Cameras will follow the same basic steps as outlined above, however, the type of equipment and user will be different. In addition, the installation and film processing will be studied, since they affect the performance of the equipment.

The approach to developing the Terms and Definitions Glossary will consist of surveying existing documents, extracting applicable data, modifying that data as appropriate, developing new definitions where necessary, and coordinating a review by industry, potential users, and other interested parties.

OBJECTIVES

The projected milestones are shown on the attached chart.

LEVEL OF EFFORT

Terms and Definitions for Police Photography	$15,000
Selection and Application Guide for Police Photographic Equipment	20,000
Selection and Application Guide for Fixed Surveillance Cameras	10,000
	$45,000

REMARKS

This project will be conducted by the Photographic Engineering Division of the Naval Ordnance Laboratory, White Oak, Maryland, as a follow-on to the lense evaluation effort being conducted under the night vision project.

GUIDES FOR POLICE AND SECURITY PHOTOGRAPHY

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Terms and Definitions for Police Photography	Sept. 72	Oct..72	Nov. 72	Dec. 72	Feb. 73
Selection and Application Guide for Police Photographic Equipment	Oct. 72	Jan. 73	Feb. 73	March 73	June 73
Selection and Application Guide for Fixed Surveillance Cameras	Dec. 72	Feb. 73	March 73	April 73	July 73

*Milestone 1 — Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 — Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 — Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 — Completion of technical review and formal submission of the document to NILECJ.

Marshall Isler, Program Manager
Security Systems

Project Plan for Guides for Burglary Alarm Systems

SCOPE

The purpose of this project is to develop a series of documents directed toward the consumer that will assist him in understanding burglar alarm systems and components well enough to allow him to negotiate intelligently with the seller. The two types of documents to be prepared are burglar alarm terms and definitions, and selection guides for burglar alarm components and systems.

BACKGROUND

Alarm systems have played a major role in the deterrence of burglary and the apprehension of burglars. The present rising burglary rate has significantly increased the demand for such systems. Consequently, the market is flooded with devices and systems covering a wide spectrum of sophistication and quality, all claiming to be the ultimate in protection. Generally, the consumer is not well enough informed to determine the devices or systems that are most appropriate for his needs, nor can he afford an independent consultant for professional advice. Therefore, there is a need for tutorial documents that will assist the consumer in making rational decisions. The performance standards presently being developed by LESL only address the false alarm susceptibility of these systems, and do not present sufficient information on selection rationale to satisfy this need.

PROPOSED PLAN

The glossary of terms and definitions will consist primarily of existing terms and definitions accepted by industry, written in a form useful to the consumer. The approach will be to survey existing documents, extract applicable data, modify that data as appropriate, develop new definitions where necessary, and coordinate a review by industry, potential users, and other interested parties.

The Burglary Alarm Selection Guides will be a series of documents pertaining to the types of systems and components available to the consumer. It is presently perceived that the following five selection guides will be generated: Burglary Alarm Systems, Interior Perimeter Sensors, Interior Area/Space Sensors, Manual Hold-up Devices, and Outdoor Sensors. Each guide will describe the various types of systems or sensors within that category, any special security features available with each type, and discussion of the advantages, disadvantages and appropriate application of each type and feature.

Generally each document will be developed in parallel with the development of standards for that particular category. Therefore, the documents will reflect the data and experience gained in the standards development process.

The requested funding for FY-73 provides for work on two of these documents: the Glossary of Burglary Alarm Terms and Definitions, as previously described, and the Selection Guide for Interior Perimeter Sensors. Interior perimeter sensors are those devices which protect the walls and entry points of a buidling. Such devices include magnetic, mechancial, and mercury switches, vibration detectors, photoelectric devices, and window foil.

OBJECTIVES

See the attached table for the projected milestones.

LEVEL OF EFFORT

Glossary of Burglary Alarm System Definitions and Terms	$10,000
Selection Guide for Interior Perimeter Sensors	20,000
	$30,000

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Glossary of Burglary Alarm System Definitions and Terms	Oct. 72	Dec. 72	Feb. 73	Mar. 73	Aug. 73
Selection Guide for Interior Perimeter Sensors	Dec. 72	Feb. 73	May 73	June 73	Sept. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Avery T. Horton, Program Manager
Emergency Equipment Standards

Project Plan for
Lights and Sirens

SCOPE

Conduct tests to determine the physical characteristics of siren signals and flashing lights and the human response to those signals; as appropriate prepare draft standards.

BACKGROUND

For both light and sound signals, effectiveness is strongly influenced by the intensity of the signal. However, significant contributions are also made by other factors, such as spectral content, interruption rate, pulse length, and similarity of the background. There is some limited knowledge of the way in which each of these factors separately influences the effectiveness of a simplified signal, but the data is far from comprehensive. Very little is known about the interactions of these factors, so that even with a very thorough set of physical measurements on a signal unit, there is no model currently available for predicting how well the signal will serve to attract attention. The only way to assess signal effectiveness, therefore, is to expose observers to the signals and to measure some aspect of their response that is thought to correlate with the conspicuity of the signal.

PROPOSED PLAN

Two independent projects will be undertaken. One for Sirens and one for Flashing Lights. In each study the physical characteristics of available equipment will be tested and the human response to the generated signals will be ascertained by experiments with human observers. These data will serve as the technical inputs for the next step, the writing of the standard. These tests will be conducted by the Applied Acoustics and Illumination Section of the Building Research Division of the National Bureau of Standards.

OBJECTIVES

The objectives of the Emergency Equipment Program is to develop standards for emergency equipment used by police officers, a standardized package of emergency equipment for police cars, and procedures for officers in the use of the equipment. The milestones are given in the attached table.

LEVEL OF EFFORT

		$K	M/Y
Task 1	Interim Standard and Report on Lights	68	1.7
Task 2	Interim Standard and Report on Sirens	107	2.7

REMARKS

As preliminary results are obtained, the relative emphasis on the several phases of the program will be subject to adjustment.

This is the second year of an ongoing program. Dates are based on the full funding being available at the beginning of FY-73.

Sirens

Physical Quantities in Laboratory

Anechoic Chamber

Anechoic chamber measurement of the physical output of sirens. The siren is operated in its several modes and detailed measurements are made of the audio radiation patterns, i.e., the spatial, temporal, and frequency distributions of the siren output. The siren is fixed on an angular indexing head during these measurements (comparable to the optical goniometer) or else results are taken from a number of microphones, appropriately positioned, so that the spatial signal distribution is obtained. Siren signals are processed by analog and digital computer techniques (for example, fast Fourier transform). This method is more costly than reverberation chamber studies, but provides the detailed signal information required for siren design and standardization. About 4 sirens would be tested in the anechoic chamber.

Reverberation Chamber

Reverberation chamber measurement of the physical output of sirens. The siren is operated in its several modes, and third octave and signal number (linear, A-weighted, C-weighted) measures of the total sound power are obtained. The reverberation chamber averages out variations with direction, and provides comparisons between sirens in terms of the total sound power output. This method is less expensive than anechoic chamber work, and the results are directly applicable to selecting sirens for use under the hood of cars (within the engine compartment) assuming total sound power to be the most important consideration. About 15, including the four mentioned above sirens, will be tested in the reverberation chamber.

Physical Quantities in Field

Stationary Source

Field measurement of physical output of sirens on test stand or on stationary test vehicle. The measurement technique used by the California Highway Patrol is to operate the siren on a test stand and measure the result at 100 feet over a grassy field. Measurements are made at 0 degrees and at ± 45 degrees. For comparison, similar tests will be made and modifications tried to determine how well this simple procedure correlates with other physical test data. Field measurements also will be made with the siren mounted in its usual location on a test vehicle. This is particularly important in the case of under-the-hood configurations to determine how much of the sound energy goes toward the front and how much is lost to the sides or rear.

Moving Source

Field measurement of physical output of sirens on test vehicle at highway speeds. Test vehicles will be operated with a number of different sirens, and at various speeds from 30 to 70 miles per hour, along a 1000 foot length of road or airstrip. Sound pressure levels will be determined at an array of microphone locations and the results will be analyzed by analog and digital techniques. Field tests of this type will help to establish the effects of vehicle speed and of multipath acoustical interference on the siren signal as it is actually presented to the target vehicle.

Cab Attenuation

Measurement of cab attenuation of typical target vehicles. A siren is operated at several selected distances and the sound levels are compared within typical stationary target vehicles, and at the same location when the target vehicle is not present. The difference in sound level is a measure of the cab attenuation. Alternately, a broad spectrum white or pink noise source can be used and the attenuation determined for siren signals other than the specific one under consideration.

Background Levels

Measurement of background sound levels within target vehicles. Typical cars and trucks are operated at various vehicle speeds with windows open and shut and the background sound levels are measured. The effects of radio and air conditioner operation are also determined. Sound levels must also be recorded while operating in traffic because noise of other moving trucks and cars also contributes to the background sound levels that the siren signal must overcome.

Health and Safety

Measurement of siren sound levels within the cab of police vehicles. Sound levels will be determined within the cab of the moving vehicle with windows open and closed for various types and locations of sirens. Results will show (1) likelihood that the operator could hear the siren of another police car, (2) amount of speech interference likely and (3) the compliance of the cab environment with the hearing safety provisions of the Occupational Safety and Health Act. It is widely believed that many fire personnel suffer hearing loss from the operation of their sirens. Tests would be conducted with standard electronic and electro-mechanical sirens mounted on the roof and under the hood, and also with the higher power sirens that are not presently common for police use.

Human Response

Conspicuity Judgments

Laboratory measurements of the human response to sirens in the presence of masking noise (judged conspicuity). Observers, under the direction of a psychologist, will listen to pairs of recorded sounds, presented alternately; and will state which siren is judged more attention-attracting. The siren sounds will be presented one after the other in the presence of background noise and all comparisons will be done twice. For the second presentation, the order of presentation will be reversed. The background will consist of sounds recorded within test vehicles in traffic, or simultations thereof, and will represent the actual types of noise level that the siren must overcome in order to be noticed.

Threshold Levels

Laboratory measurements of the (raised) human threshold of response to sirens in the presence of masking noise. In a procedure somewhat like a standard audiometer test, recorded siren signals will be presented to the subject at varying levels while mixed with varying levels of typical background noise. Subject will be asked to state when he hears the siren, and his threshold will be determined for the various background conditions. All subjects will be tested for hearing acuity -- some subjects with poor hearing will be included.

Report Preparation

Data Analysis

Detailed analysis of both the physical and psychophysical data, and preparation of summarized presentations and reports. Extensive hand and computer analysis are required to "digest" the raw field and laboratory results into formats that will be useful in the preparation of standards.

Coordination of Results

Coordination of the physical data and the human response results to establish which physical factors determine device effectiveness. As stated above, effectiveness is strongly influenced by the intensity of the signal. However, significant contributions are also made by other factors, such as spectral content, cycling rate, pulse length, and similarity to the background. Very little is now known about the interactions of these factors, so that even with a very thorough set of physical measurements on a siren, there is no model currently available for predicting how well the signal will serve to attract attention. The only way to assess signal effectiveness, therefore, is to expose observers to the signals and to measure their response. This establishing of the physical factors determining conspicuity is the end purpose of all the test efforts.

Preparation of Standards

Preparation of standards. After all of the above has been completed, draft standards will be prepared. The standards will describe the physical characteristics of the required warning signals, and will be submitted to NILECJ after they have had NBS approval.

Lights

Physical Quantities in Laboratory

Standard Physical Tests

Laboratory measurement of the physical output of a variety of lamps, domes, and assembled lighting units, using standardized laboratory test procedures. The spatial intensity distribution of 8 selected types of incandescent lamps will be measured by horizontal and vertical sweeps using a goniophotometer. Colorimetric measurements will be made on two of these types of lamps with clear, red, yellow, and blue faces, in order to accurately characterize the color for correlation with subjective response. Flash pulse shape will be determined for 13 selected warning light units; and for several of these units the photometric and colorimetric results will be repeated with different colors of domes. Some of the same type of bulbs and PAR lamps will be used during these tests.

Strobe Program

Laboratory measurement of the physical output of selected "strobe" lights on the NBS photometric range. The intensity distribution will be measured through a full 360 degrees horizontally and through ± 15 degrees of vertical angle for 6 typical "strobe" light units. This will involve high speed photometric circuitry to determine the instantaneous intensity versus time. The color of the signal will be determined using high speed spectroradiometric techniques for red, yellow, blue and clear domes.

Physical Quantities in Field

Stationary Source on Rooftop

Field measurement of the physical output of those lights used for human response testing. A high quality telephotometer will be used for field measurements of the physical output signal of the lights. The field aperture of the telephotometer will be adjusted so as to include the whole warning light unit, and highspeed circuitry will be used with the telephotometer photomultiplier output to determine the instantaneous intensity relative to the background light levels.

Human Response

Conspicuity Judgments

Field measurement of the human response to warning lights by judged conspicuity. The observer fixes his eyes on a steady target straight ahead of him. Then two light signals appear, equally far on either side of the fixation target. The signals will be generated by commercial units containing flashing or rotating lights. The observer keeps his gaze straight ahead, and decides which of the lights, in the periphery of his visual field, seems to be attracting his attention more powerfully. His response consists of a simple indication of which unit is more conspicuous. Several observers will make a series of these direct paired comparisons, in which various light units are compared to each other. Standard statistical techniques allow the derivation from these "left-right" responses of numberical scale values that can be assigned to each unit involved in the tests as an index of its effectiveness.

The lights are not viewed directly because the visual responses of the eye are different in the center and off in the periphery, and what we are seeking to do is to make signals most noticeable when they appear in the rear-view mirror or well off to the side. There is little trouble seeing a flashing light on a vehicle coming straight at you.

Report Preparation

Data Analysis

Detailed analysis of both the physical and psychophysical data, and preparation of summarized presentations and reports. Extensive hand and computer analysis are required to "digest" the raw field and laboratory results into formats that will be useful in the preparation of standards.

Coordination of Results

Coordination of the physical data and the human response results to establish which physical factors determine device effectiveness. As stated earlier, effectiveness is strongly influenced by the intensity of the signal. However, significant contributions are also made by other factors such as color, flash rate, flash duration, and similarity to the background. Very little is now known about the interactions of these factors, so that even with a very thorough set of physical measurements on a signal unit, there is no model currently available for predicting how well the signal will serve to attract attention. The only way to assess signal effectiveness, therefore, is to expose observers to the signals and to measure their response. This establishing of the physical factors determining conspicuity is the end purpose of all the test efforts.

Preparation of Standards

Preparation of standards. After all of the above has been completed, draft standards will be prepared. The standards will describe the physical characteristics of the required warning signals and will be submitted to NILECJ after receiving NBS approval.

LIGHTS AND SIRENS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Interim Report & Standard on Flashing Lights	Continuing	Aug. 72	Oct. 72	Dec. 72	March 73
Interim Report & Standard on Sirens	Continuing	Sept. 72	Dec. 72	March 73	June 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Robert Mills, Program Manager
Concealed Objects Detectors

Project Plan for
Metal Detectors

SCOPE

Performance standards will be developed for three types of metal detectors used by law enforcement officials. The first standard relates to walkthrough metal detectors, which are intended to indicate the presence of metal in excess of a specific amount carried on the body of a person passing through a specific space. The second standard will relate to handheld metal detectors, which are small, portable devices intended to indicate the presence of excessive metal when held close to a person being examined. The third standard will be for buried metal evidence detectors which are designed to detect metal objects under soil, cement, snow, and in some cases, under water. All of these standards will apply to both active and passive metal detectors. An active metal detector generates an electromagnetic field in the detection space. It responds to any type of metal, but may be designed to indicate only ferrous metal. A passive metal detector does not intentionally generate any electromagnetic field within the detection space. It responds to ferromagnetic metal only.

BACKGROUND

Metal detectors are on the market for use at prisons, airports, computer facilities, courtrooms entrances and entrances to other public building. They can also be used to protect important officials during public appearances and to search crime scenes for evidence. However, many potential users need assistance in understanding the performance which can be expected from these devices, and in making a judicious selection from available models. These performance standards, when completed, will provide assistance to these users by cataloging the performance criteria which are important in purchase specifications, and by establishing minimum acceptable levels of performance. The standards will also include test procedures for determining compliance of the devices with the performance requirements.

PROPOSED PLAN

The test procedure for determining detection sensitivity will be the most important one in all three metal detection standards. The approach used in the walk-through detector standard, which will probably be used in the other standards, is to check for detection of standardized test objects. There must be a good correlation between these tests and actual weapon or evidence detection under operational conditions. A large amount of laboratory work is necessary to establish this correlation.

Normally, detection sensitivity and false alarm rates are inverse characteristics of detectors; one can be improved, but only at the expense of the other. A few manufacturers are attempting to improve detection sensitivity of walk-through devices by experimenting with discrimination logic (i.e., designs which improve the chances of the detector distinguishing between a weapon and other similar but harmless metal objects). However, to date, few if any workable discrimination designs have reached the market, and the first standard for walk-through devices will not contain a test specifically for discrimination. Such a test can be added later, if necessary. The development of the test will probably be somewhat difficult.

Acceptable levels of detection sensitivity and false alarm rates will depend on the particular application. For example, the required detection sensitivities for prisons and airports are clearly different. It will be important that the performance levels specified in the draft standards for the various applications be carefully reviewed by knowledgeable users.

Other test procedures must be developed for determining the effects of external influences (e.g., swinging metal doors, temperature changes, supply voltage changes, etc.) on the normal operation of the detectors, and acceptable limits for these effects must be established. Test procedures are necessary for determining the electrogmagnetic field strengths which are associated with active walk-through and handheld detectors. It has been suggested that the fields from these metal detectors may interfer with the operation of human heart-pacemakers. If possible, safe field strengths should be determined.

The detection sensitivity test for buried evidence detectors will involve determining the size of the smallest detectable metal object at various depths of the object below the surface. Laboratory and field tests will be necessary to perfect a test procedure for this standard.

OBJECTIVES

The projected milestones are shown on the attached table.

LEVEL OF EFFORT

A total of $27,000 is requested for FY-73 to complete the three standards listed under Objectives. $41,000 was spent in FY-72, $5,000 in FY-71. The same project engineer at NBS who developed the walk-through detector standard will be able to continue the development of standards for handheld detectors and for buried evidence detectors.

METAL DETECTORS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Walk-through Metal Weapon Detectors	Continuing	Completed	Completed	July 72	Nov. 72
Standard for Handheld Metal Weapon Detectors	Continuing	Completed	Sept. 72	Jan. 73	May 73
Standard for Buried Metal Evidence Detectors	Dec. 72	Feb. 73	April 73	July 73	Nov. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Robert M. Mills, Program Manager

Concealed Objects Detectors

Project Plan for Detectors Utilizing X-Rays or Neutrons

SCOPE

This project includes the development of standards for x-ray equipment used to search inanimate objects in discrete item and screening operation applications, and a standard either for explosives detectors using neutron beams or for x-ray equipment to search animate objects.

BACKGROUND

X-ray equipment has important law enforcement applications as weapon, narcotic and bomb detectors. Two types of x-ray equipment are used to search inanimate objects: one is used to examine discrete items suspected to contain explosives or incendiary material; the other is used in routine screening operations where, for example, briefcases and handbags are to be searched at critical areas of public buildings. New instruments having extremely low radiation hazard levels promise to have high utility for these uses, and open the possibility of using x-ray equipment to search animate objects. Upon completion of the development of the two standards for searching inanimate objects, work will begin either on a standard for x-ray devices to search animate subjects or on a standard for detection equipment using neutrons. Equipment utilizing slow neutron beams has proven to be effective in detecting bulk explosives.

Performance standards will assist users in understanding the performance to be expected from x-ray and neutron beam devices and in making a judicious selection from the various types of detection equipment available. Standards will also help to protect operators and others from exposure to unsafe radiation levels.

PROPOSED PLAN

The first step in the development of each of these standards involves collecting and studying the relevant literature, and surveying the x-ray and neutron beam hardware available on the market. Apparent user requirements must be determined via contacts with present and future users, and with NILECJ and MITRE.

Laboratory tests are needed to verify some of the performance claims of the hardware manufacturers, and to check the appropriateness of test procedures under consideration for inclusion in the standards. Considerable expense has been saved by performing laboratory tests on x-ray equipment made available by the U.S. Postal Service Laboratory in Rockville, Md.

The important performance criteria, such as image quality, radiation hazards (hazards from the beam and from leakage radiation), and portability will be determined for each standard. Appropriate test procedures will be selected or devised, and acceptable performance levels will be established.

OBJECTIVES

See the attached chart for projected milestones.

LEVEL OF EFFORT

Work for this project began October 15, 1971, within NBS and has been continuing at an annual rate of approximately 1.2 man/year. Project costs for FY-72 are expected to be $42,500; $60,000 are requested for FY-73.

REMARKS

An article entitled, "X-Ray Standards for Law Enforcement" appeared in the May 1972 issue of The Police Chief.

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for discrete item x-ray equipment.	Continuing	Completed	Completed	Aug. 72	Dec. 72
Standard for screening operations x-ray equipment	Continuing	Completed	Aug. 72	Oct. 72	March 73
Standard either for x-ray equipment to search animate objects or for detectors using neutron beams	Nov. 72	Dec. 72	March 73	June 73	Dec. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Robert Mills, Program Manager
Concealed Objects Detectors

Project Plan for
Narcotic Field Test Kits

SCOPE AND BACKGROUND

A standard will be developed for narcotic field test kits. These kits usually consist of a collection of chemicals which supposedly undergo unique color changes when mixed with specific narcotics or other dangerous drugs. Kits using thin layer chromatography have been tried, but are not in wide usage. Narcotic field test kits are designed for use in the field by investigators to tentatively identify suspect materials as illegal drugs and thus furnish "probable cause" for making arrests. While these kits can be valuable decision tools for narcotic investigators, they are not intended to, and cannot, furnish the conclusive analytical results which require the services of a forensic scientist and are needed to secure convictions.

This standard will help to emphasize the limitations of the kits and will also assist potential users in their selection, evaluation, and specification of available narcotic test kits.

PROPOSED PLAN

This standard will be developed within NBS, although close consultation with the Bureau of Narcotics and Dangerous Drugs (BNDD) is planned. After becoming familiar with the relevant literature and surveying the narcotic kits available on the market, the relevant performance (or, if necessary, design) criteria will be determined. These criteria are expected to include specificity (i.e., uniqueness of a positive test indication to a particular narcotic), sensitivity (i.e., quantity of narcotic necessary to produce a positive test indication), safety to user, and shelf life time. Appropriate test procedures will then be selected or devised, and the appropriateness of these test procedures will be checked in the laboratory.

It is not known, at this time, how best to express the specificity requirement. The standard might, as one alternative, include a list of troublesome substances for which the kits must be checked for possible false positive indications. This list, however, cannot be inclusive, since all substances capable of causing false positive indications for all narcotic kits cannot be known. Another alternative is to require the use of testing compounds in the narcotic test kits which belong to chemical families known from experience to have satisfactory specificity characteristics. This type of requirement, however, discourages the development of new and better types of kits. The best choice between these two approaches will be more apparent after further study.

OBJECTIVES

See the attached chart for projected milestones.

LEVEL OF EFFORT

It was necessary to commit $21,000 of FY-73 funds at the time of initiation of this project in June 1972. An additional $7,000 of FY-73 funds will be needed for this project. (Note that this $7,000 was not requested in the LESL Program Plan submitted in May 1972. The estimated time for completing the project and the cost have had to be increased as the tasks were better defined.)

NARCOTIC FIELD TEST KITS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Narcotic Field Test Kits	Continuing	Sept. 72	Dec. 72	Feb. 73	May 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Robert Mills, Program Manager
Concealed Objects Detectors

Project Plan for Trace Vapor Detectors

SCOPE AND BACKGROUND

Standards will be developed for trace vapor detectors which are devices designed to indicate the presence of minute concentrations of explosive or narcotic vapors. Trace vapor detectors can be used, for example, to check unopened packages or luggage, or they can be used to detect traces of explosive vapors or dangerous drugs on the hands or clothing of persons who have recently handled these substances. In some cases, they can provide limited qualitative information about the type of explosive used after an explosion has occurred.

A variety of trace vapor detector designs are being developed or have already reached the market place. The best known device which can be purchased today is a small gas chromatograph having a special sampling valve at the intake of the instrument to selectively concentrate the explosive vapors in the sample. Another marketed device monitors the luminous area of cartridges containing light emitting (bioluminescent) organisms. These organisms have been found to be sensitive to trace quantities of explosives in the surrounding atmosphere. A third device on the market, known as a plasmatron, uses beta rays to form negative ions. Negative ions formed from explosive vapors are distinguished from others by measuring the ion drift velocity through a drift space. The plasmatron resembles a time-of-flight mass spectrometer, except that it operates at atmospheric pressure. Several laboratories are experimenting with the use of small conventional mass spectrometers (magnetic, time-of-flight, or quadrupole) as trace detectors, some using special membranes at the sample inlet to selectively pass explosive vapors.

At the present time, it is difficult for even knowledgeable technical people to know which of these instrument designs offer the best performance in important characteristics such as sensitivity (lowest detectable vapor concentration sampled over a given sampling time period) and specificity (uniqueness of an alarm indication to the presence of specified vapors; specificity is closely related to the false alarm characteristics of the instrument). Test procedures which can be used to compare the performances of available instruments will therefore be valuable. Manufacturers will also benefit by knowing the performance levels for which they must design in order to market a useful instrument.

PROPOSED PLAN

Due to the variety of trace vapor detector designs, a decision will have to be made concerning the scope of the standard or standards to be written. A single performance standard may be possible using language general enough for all types of detectors (e.g., gas chromatographs, bioluminescent instruments, etc.). However, it may be necessary to write a standard having specialized sections, or perhaps separate standards will be necessary. The milestones listed under Objectives assume a single standard will be written.

By far the most important test procedures in this standard will be for sensitivity and specificity. It will be necessary to have some qualitative and quantitative information about the residual vapors from narcotics and explosives. Some of this information may be available from the literature or from other laboratories. If not, it will have to be obtained in NBS laboratories. Then, test procedures can be devised which reliably produce the proper trace concentrations of appropriate vapors.

OBJECTIVES

The attached chart gives the projected milestones.

LEVEL OF EFFORT

Once initiated in mid FY-73, approximately a one man-year project is planned. $30,000 is requested for FY-73. An estimated additional $20,000 will be requested for use in FY-74. The work will be done within NBS.

TRACE VAPOR DETECTORS

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Standard for Trace Vapor Detectors	Jan. 73	March 73	Aug. 73	Oct. 73	Feb. 74

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Robert Mills, Program Manager
Concealed Objects Detectors

Project Plan for
Gunshot Residue Detection

SCOPE

The objective of this project is to develop a recommended procedure for the detection of gunshot residues using the cotton swab technique for residue collection and neutron activation analysis for residue analysis. This recommended procedure will give guidelines for performing gunshot residue tests, and will give the statistical reliability which can be expected for certain test circumstances. The recommended procedure will not be represented as necessarily the only satisfactory procedure for doing gunshot residue tests, but instead, as one techni ue having known reliability.

BACKGROUND

Cartridge primers of modern ammunition contain barium (Ba) and antimony (Sb) salts. Upon detonation of the cartridge, traces of these elements are deposited on the shooters hand due to gas leakage around loose fitting gun parts and to blow back from the muzzle.

Two techniques are currently used to remove the Ba and Sb residues from the suspect's hand. One technique involves applying melted paraffin in layers reinforced with gauze to the hand. This project, at least initially, will be involved only with the technique which uses cotton swabs, moistened with dilute HNO_3 to remove the residue.

Neutron activation analysis has proven to be a valuable method for measuring the amount of gunshot residue. Any Ba and Sb which is on the cotton swabs is made redioactive through the use of neutron flux from a nuclear reactor. The gamma-ray radiation emitted by the radioactive Ba and Sb salts is then determined by comparing the emitted radiation from the residues with radiation from Ba and Sb standards. Concentrations of Ba and Sb significantly above background levels (approximately 60 nanograms of Ba and 20 nanograms of Sb) provide evidence that the suspect has fired a weapon in the recent past.

There are, of course, limits to the circumstances under which the collection and analysis of gunshot residues can be expected to give reliable results. For example, the amount of residue which remains on a suspect's hands is reduced if he showers, washes his hands or just sleeps in a bed. There have been cases where gunshot residue tests have been attempted even though it was known that the suspect had washed his hands several times after finger printing. The resulting questionable results unfortunately have cast doubt on the entire technique. There is a need for a recommended procedure giving detailed instruction for gunshot residue collection and analysis which when followed will give results of known reliability. There is also a need to carefully investigate the effect on the reliability when the test is conducted under less than optimum circumstances.

PROPOSED PLAN

This project will be conducted at NBS. It will not be necessary to spend significant time gathering background information since NBS scientists have been involved in using the nuclear reactor here for analysis of gunshot residuals and are familiar with the present state-of-the-art. NBS also has available considerabe expertise in statistics which will be needed to design experiments and to analyze the results in the determination of procedural reliabilities.

The laboratory work will be done in three phases. In phase I some rather general questions will be investigated such as (a) the amount of Ba and Sb which can be expected on the hands of the general population who have not fired weapons, (b) the importance of the choice of cotton used to make the swabs, and (c) the choice of test procedures during residue analysis, such as neutron irradiation time and intensity. During phase II, actual gunshot residues will be obtained and analyzed, using a small number of weapons and persons for collecting samples. A tentative procedure for residue collection will be established and the effect on reliability of such factors as bathing will be determined. In phase III, a large number of weapons and actual law enforcement investigators will be used to obtain residue collection data under realistic operational conditions. Final recommended procedures will be established for residue collection and for residue analysis in phase III, and any remaining data necessary to determine reliability statistics will be obtained. It is hoped that the necessary involvement of law enforcement officials can be obtained through collaboration with such groups as the American Society for Testing and Materials (ASTM), and the Association of Official Analytical

Chemists (AOAC). ASTM, for example, has two committees which might be interested in this project: the Committee for Forensic Science and the Committee for Neutron Activation Analysis. These groups can also provide valuable contacts during the review procedure for the recommended procedures.

OBJECTIVES

The attached table shows the projected milestones.

LEVEL OF EFFORT

$45,000 is requested for FY-73, and an additional $20,000 will be requested in FY-74 to complete this project. These funds will pay for approximately a one man-year effort.

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Recommended Procedure for the Analysis of Gunshot Residues	Oct. 72	Nov. 72	Feb. 73	Sept. 73	Dec. 73
Recommended Procedure for the Collection of gunshot Residues	Oct. 72	Nov. 72	July 73	Sept. 73	Dec. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jared J. Collard, Acting Program Manager
Police Vehicle Standards

Project Plan for
State-of-the-Art Survey: Police Patrol Automobiles

BACKGROUND

Expenditures for police patrol automobiles exceed those for any other item of equipment purchased by law enforcement agencies. Approximately 65,000 patrol cars are purchased each year at an estimated annual cost of $260 million, including all modifications except radio equipment.

With the occasional exception of braking and acceleration, police agencies purchasing patrol cars customarily specify requirements in terms of desired options, rather than performance, i.e., engine displacement, tire size and type, body style, etc. Selecting a particular option does not assure an acceptable level of performance. In addition, the terms used to specify vehicle options do not have standard meanings. For example, terms such as "police package," "heavy duty suspension," and "heavy duty radiator" are not precise definitions.

PROPOSED PLAN

This project, the study of the state-of-the-art of police patrol cars, is one of the principal efforts of the FY-73 Police Vehicle program. Its purpose is to prepare the base for a full technical effort in this program area in FY-74. This study will involve several parallel efforts.

First, working relationships will be developed with such groups as the National Association of Fleet Administrators (NAFA), a "user" group, the Society of Automotive Engineers (SAE), a "technology" group, as well as other pertinent organizations.

Second, a collection will be made of all appropriate and current specifications and guidelines, including those of the Federal Government, state and local law enforcement agencies, SAE, the Tire and Rim Association, and others. This collection will provide fuller knowledge and understanding of the vehicles and options law enforcement agencies are purchasing for patrol cars. Also, existing literature will be searched in an effort to ascertain known performance requirements and characteristics of police patrol cars.

Third, a preliminary search will be made of appropriate patent literature. Based upon inadequecies of police patrol cars disclosed by the NILECJ/TAD equipment questionnaire, a survey of current patents will be made in two or three key areas to determine whether technology exists which, if developed, could improve the current police patrol cars. This survey would also determine whether a fuller, in-depth study is feasible.

Finally, a glossary of police automobile terms and definitions will be compiled.

OBJECTIVES

The outputs of this project will consist of a glossary of terms and definitions and a report on the findings of the patent survey. The milestones are shown on the attached chart.

LEVEL OF EFFORT

The total cost of the state-of-the-art survey is estimated at $25,000. The project should be completed approximately six months after receipt of the funding. All work will be performed in NBS, with assistance from such groups as NAFA and SAE.

7/25/72

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
Glossary	Sept. 72	Jan. 73	--	Feb. 73	April 73
Patent Survey	Sept. 72	Dec. 72	--	Jan. 73	Feb. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jared J. Collard, Acting Program Manager
Police Vehicle Standards

Project Plan for Life Cycle Costing of Police Patrol Vehicles: Acquisition, Maintenance and Disposition

BACKGROUND

The most expensive category of equipment used by police in providing their services to the public is the police patrol vehicle. At present there are over 200,000 of these nationwide with approximately one third of them (65,000) being replaced annually. The average cost per car including modifications, is approximately $4,000 (exclusive of communications equipment). Thus, total costs approximate $260 million a year nationwide. All major car manufacturers sell police cars which are standard sedans with special "police" options available.

Present methods of procurement of police vehicles vary throughout the nation. Some police departments write their own specifications for vehicles, submit them for low bids, purchase them and maintain them. Other departments purchase vehicles and contract out maintenance. Some departments lease their vehicles and others are considering a trade-in plan with the manufacturers.

Current methods of disposition of police vehicles also vary considerably. In some cases vehicles are sold at a specific age, in some at a specific mileage, and in others at some combination of the two. The existence of such a variety of practices suggests that inefficiency may exist in the system, although local conditions may justify some variation.

PROPOSED PLAN

The primary objective of this study is to analyze current police practices for the acquisition, maintenance and disposition of police patrol vehicles and to develop guidelines for police agencies. In reaching this goal, several important questions will be answered.

1. What are the present methods of and criteria for acquisition, maintenance, and disposition of police patrol cars?

2. Are the present methods cost effective?

3. What alternate methods are available?

4. In view of the basic performance requirements and existing deficiencies as pointed out by such studies as the Technical Analysis Division's Police Equipment Survey, is there a need for specific performance standards for police patrol vehicles? Is there a need for a specially designed police patrol car?

Work will be carried out in the following areas:

A. Literature Search: An extensive literature search will be conducted in the area of life cycle costing of vehicles. Additionally, a search for readily accessible data regarding all aspects of acquisition, maintenance and disposition of police patrol cars will take place. Much information will be drawn from the survey conducted by the Technical Analysis Division, as well as from other sources of information available to LESL and TAD.

B. Current Methods Inquiry: Material obtained from the TAD questionnaire and data obtained through the literature search will be augmented through contacts with the National Association of Fleet Administrators, the Society of Automotive Engineers and other professional groups in order to characterize current costs, acquisition and disposition methods, maintenance practices and subsystem life times.

C. Life Cycle Costing Investigation: Present practices will be investigated for cost effectiveness and deficiencies or problems in the existing system will be isolated. An investigation of possible alternative methods of procurement, maintenance and disposition will be conducted as well as a cost analysis of each. Some of the possible alternatives for study are:

   1. Manufacturing a standardized police patrol vehicle which could be purchased or leased by all, or nearly all, police departments.

   2. Establishing standards for police patrol vehicles which could be manufactured by any automotive company and sold or leased to police departments.

   A comparison of police patrol car procurement and maintenance practices with those for other public service vehicles will be undertaken to identify those desirable and undesirable features which would help to pinpoint the proper practices for police patrol vehicles.

D. Preparation of Guidelines: Guidelines will be prepared for the most cost effective and desirable method of procurement, maintenance and disposition of police patrol vehicles.

OBJECTIVES

The output of this project will be in the form of an NBS Technical Report which will contain: (A) a bibliography of other published work concerning the acquisition, maintenance and disposition of police patrol cars; (B) a financial analysis of current methods; (C) a comparison of current police car procurement, maintenance and disposition practices with other public service vehicles; and, (D) guidelines and recommendations for the most cost effective methods. See the attached table for the projected milestones.

LEVEL OF EFFORT

The total cost of this study is estimated at $45,000. A total elapsed time from the initiation date of the project to LESL's receipt and acceptance of a draft report is estimated to be six months, with final NBS review and publication, taking an additional six weeks.

LIFE CYCLE COSTING OF POLICE PATROL VEHICLES: ACQUISITION, MAINTENANCE AND DISPOSITION

Objectives	Assumed Starting Date	Milestones* #1	#2	#3	#4
NBS Technical Report	Sept. 72	Feb. 73	--	March 73	May 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Weapons Standards

Project Plan for
Tear Gas Devices

BACKGROUND

While there are only two tear gases in use by law enforcement agencies, CN and CS, there are a great many devices in use to dispense these gases, including grenades, cannisters, handheld liquid and powder dispensers, bulk generators, etc. There is a general lack of familiarity with the exact characteristics, potential hazards and tactical uses of the great variety of available devices, chemical formulations, and dispersal mechanisms, and they are thus easily mis-used. Some devices are intrinsically dangerous, such as the gas-billy that has blinded several people and the cannister that is prone to set fire to buildings.

PROPOSED PLAN

As a first step, the available types of tear gas devices will be evaluated in terms of all use situations requiring any degree of force. Two types of devices, for use in the tactical situations deemed to be of great immediate importance to law enforcement, will be selected for standardization and a contract awarded to do the work. Col. Rex Applegate is being hired as a consultant to LESL in this program area and will assist the Program Manager in planning, evaluating and reviewing the experimental effort and the standards developed.

OBJECTIVES

Two standards will be developed and submitted to NILECJ.

A user guideline on the selection, use and characteristics of tear gas devices will also be written. The projected milestones are given in the attached table.

LEVEL OF EFFORT

$90,000 is being budgeted for this effort. It is estimated that one man-year of effort will be required for the evaluation of each device and that the user manual can be written for $10,000.

The work will be contracted out on a competitive basis. Possible bidders include the IIT Research Institute, Franklin Institute Research Labs., Cornell Aeronautical Labs., and the Edgewood Arsenal.

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
First Tear Gas Standard	Nov. 72	Jan. 73	May 73	Aug. 73	Jan. 74
Second Tear Gas Standard	Nov. 72	Jan. 73	July 73	Sept. 73	Feb. 74
User Guideline.	Nov. 72	July 73	--	Oct. 73	Mar. 74

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

Jacob J. Diamond, Program Manager
Weapons Standards

Project Plan for
Police Ammunition

BACKGROUND

The Standards Committee of the Sporting Arms and Ammunition Manufacturers Institute is in the process of reviewing their industry standards for firearms ammunition and for the methods of testing the ammunition. They have been doing this for over a year and from time to time have furnished LESL with copies of their standards as they agree to them. They are currently working on the test methods.

Remington-Peters, Winchester-Western, and Federal are SAAMI members, but Super Vel and some other manufacturers are not. There is no certainty, therefore, that the SAAMI standards describe the entire industry practice.

PROPOSED PLAN

No action is planned until the SAAMI committee has completed its deliberations and its submissions to LESL. At that time the project will be actively pursued and a standard drafted. Present thinking is that the standard will include essentially all bullet variations available in the cartridge types used by law enforcement agencies; if a bullet type can be fired in a particular police weapon, it must be expected that some department or officer will do so.

Performance characteristics which will be considered for inclusion are mean muzzle velocity (probably using a standard test barrel), the dispersion of muzzle velocities, generated pressure, bullet weight, and group dispersion when fired from a standard barrel.

While cartridge dimensions and tolerances are critically important in the manufacture of ammunition, which must properly fit the weapon chamber, it is not clear at this time whether or not they should be included in a NILECJ standard for police ammunition.

OBJECTIVES

The projected output of this project is a standard on police ammunition. The projected milestones are given in the attached table.

LEVEL OF EFFORT

The projected cost of this project is $10,000. The three man-month effort would involve editorial work, but no testing at all.

POLICE AMMUNITION

Objectives	Milestones*				
	Assumed Starting Date	#1	#2	#3	#4
Standard on Police Ammunition	May 73	July 73	--	Sept. 73	Feb. 74

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

TEAR GAS DEVICES

Jacob J. Diamond, Program Manager
Weapons Standards

Project Plan for
Police Handguns

SCOPE

This project involves the development of a performance standard for handguns used by law enforcement personnel. It is not concerned with handgun ammunition or with target effects.

BACKGROUND

The handgun is the primary weapon used by law enforcement personnel in the United States. While other firearms are used in certain situations, the handgun is the only one routinely carried by nearly all officers.

The .38 Special revolver is by far the most popular service handgun; others include the .357 Magnum revolver and the 9mm automatic pistol. A great variety of off duty handguns are in use, but again the .38 Special revolver is predominant, with the .32 caliber revolver also popular.

Most law enforcement officers consider the handgun their most important item of equipment, although many never have occasion to use it on a service call during their entire careers. When they do use it, of course, it is often a matter of life or death for them. A handgun performance standard is thus of primary important to law enforcement personnel.

PROPOSED PLAN

The approach to this project will be to subject to test and evaluation a group of the more important handgun models currently being purchased by law enforcement officers, and to write a standard based on the findings of the test program. The tests will be designed to determine the safety, accuracy, reliability and quality of the weapons.

Safety to both the shooter and to bystanders will be considered. Revolvers will be tested for the extent to which they shave lead from bullets jumping the cylinder to barrel gap. All weapons will be tested for tendency to accidental discharge, for trigger pull to effect discharge, and for the presence and efficacy of safety features.

Accuracy will be determined by measuring both the spread of a group of shots and the deviations of the mid-point of the group from the aiming point.

Reliability will be evaluated in terms of ability to continue to fire without malfunction, and ability to operate under unfavorable circumstances such as after exposure to poor environmental condition, after heating by sustained firing, and after subjection to vibration and shock. If possible, a test will be included to gauge the difficulty of returning a weapon to operating condition after it has experienced a malfunction such as failure to feed or to extract.

The deterioration of the initial characteristics of a weapon, due to extended use, is a measure of both its reliability and quality. This deterioration (due to wear, shock, metal fatigue, etc.) will be determined by re-measuring accuracy, muzzle velocity, lead spray, and perhaps other characteristics, after a firing regime designed to simulate an extended period of use.

OBJECTIVES

The objective of this project is the development of a standard for police handguns. The projected milestones are given in the attached table.

LEVEL OF EFFORT

This project is budgeted at $100,000. The work will be contracted out under RFP; among the possible contractors are the H. P. White Laboratory and the Naval Weapons Laboratory.

Objectives	Assumed Starting Date	Milestones*			
		#1	#2	#3	#4
Standard for Police Handguns	Sept. 72	Nov. 72	Apr. 73	June 73	Nov. 73

*Milestone 1 Completion of the survey of existing equipment, standards and test methods, and of detailed planning for further work.

*Milestone 2 Completion of the laboratory testing, analysis and evaluation of the data.

*Milestone 3 Completion of the first draft of the document by the project staff and its acceptance by LESL.

*Milestone 4 Completion of technical review and formal submission of the document to NILECJ.

*U.S. GOVERNMENT PRINTING OFFICE:1973 514-411/166 1-3

PUBLICATIONS OF THE
LAW ENFORCEMENT STANDARDS PROGRAM

Standards

*NILECJ STD-0101.11, March 1972. Ballistic Resistance of Police Body Armor. Stock No. 2700-0155. Price 25 cents.

Reports

†LESP-RPT-0501.00, May 1972. Emergency Vehicle Warning Devices - Interim Review of the State-of-the-Art Relative to Performance Standards, by E. T. Pierce, K. L. Kelly, M. A. McPherson, G. L. Howett and R. L. Booker.

*LESP-RPT-0201.00, May 1972. Batteries Used With Law Enforcement Communications Equipment: Comparison and Performance Characteristics, by L. L. Jesch and I. S. Berry**. Stock No. 2700-0156. Price 50 cents.

**Chargers and Charging Techniques for Batteries Used with Law Enforcement Communications Equipment, by W. W. Scott, Jr.

**Technical Terms and Definitions Used with Law Enforcement Equipment (Radio Antennas, Transmitters, and Receivers) by Frank M. Greene.

*Single copies are available from the National Criminal Justice Reference Service, Law Enforcement Assistance Administration, U. S. Department of Justice, Washington, D. C. 20530. Additional copies can be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. Please order by stock number and title and enclose remittance payable to Superintendent of Documents.

†Single copies are available from the National Criminal Justice Reference Service.

**Currently being readied for publication.

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