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RPC CORPORATION

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FINAL REPORT

ADVANCED DEVELOPMENT PROGRAM

BIOLUMINESCENT NARCOTICS/BOMB VAPOR DETECTORS

C-55684

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Submitted to:

Planning Division
New York City Police Department
346 Broadway
New York, New York 10007

Approved by _____
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President

PREFACE

Under the sponsorship of the New York City Police Department, RPC Corporation conducted an eleven-month advanced program to develop the Bioluminescent Narcotic and Bomb Vapor Detectors.

RPC Corporation wishes to acknowledge the assistance provided by the Narcotics Division and the Bomb Squad of the New York City Police Department, and the United States Army Land Warfare Laboratory, Aberdeen, Maryland who served as Technical Monitor to the program.

CONCLUSIONS

The contractual effort applied to this program, advanced the concept of detection by bioluminescence from the feasibility phase to the realistic practicality of field applications. Biosensor sensitivities were enhanced sufficiently to enable detections of dynamite vapors from various package configurations (luggage, cartons). The heroin vapors were detectable from cutting rooms and walls which were primary program objectives. Prior to this contract, it was only possible to detect heroin and dynamite vapors from a plastic container through access holes in the container. Biosensors sensitive to marijuana and cocaine vapors were also developed, although not to the extent of being used for field detections.

In conjunction with the biosensor sensitivity enhancement, engineering advances contributed to the development of an operational prototype field system. The prototype detector units are portable and can be operated from AC or DC power.

RECOMMENDATIONS

This contractual effort has demonstrated the potential usefulness of bioluminescent detection to field applications in New York for the identification of heroin and dynamite. It has been recognized that with some modifications and improvements to the system, both New York and RPC will be responsible for providing the law enforcement community with a tool which can be efficiently utilized, for detecting dynamite and heroin.

Most research activities have been conducted and evaluations of the prototype field system have permitted the police to formulate more detailed applications requirements for the device. All results thus far indicate that field equipment can be made available within a reasonable period of time with directed effort.

It is, thus, recommended that substantial effort be directed towards improving the detection system (sensor and device) in order to provide the New York Police with a system which can be utilized in the field under NYPD specifications. The proposed effort would include:

1. Continued field evaluation by NYPD and RPC personnel
2. Preparation of system specifications/requirements by the NYPD
3. Equipment improvement, fabrication and delivery
4. Simplification of sensor handling to reduce preparation requirements in the field.
5. Sensor improvements; (reduction of incubation time, increase sensor uniformity, extend sensor use times and simplify sensor preparation
6. Sensor development for cocaine.

SUMMARY

The objective of this program was directed towards the development of a portable vapor detection device to be used by the New York City Police. These efforts encompassed the isolation and development of biosensor strains sensitive to chemical vapors produced from heroin, cocaine, marijuana, dynamite and black powder. Major emphasis was placed on the development of heroin and dynamite detection systems.

Preliminary biosensor screening procedures were applied to determine the sensitivity parameters of the RPC stock cultures and newly isolated wild strains, as they were collected by the RPC Laboratories. The biosensor strains, which exhibited the ability to respond to the vapors of interest were subjected to the mutagenesis phase of the program.

The mutagenesis phase involved the exposure of selected, sensitive biosensor cultures to chemical and physical mutagens. Mutagenic activity affords an effective means of increasing biosensor sensitivity by changing the genetic make-up of the bacterial cell. Once a particular bacterial culture had been exposed to the mutagenic agents, numerous progeny were isolated and evaluated for sensitivity. Any progeny that exhibited an increase in sensitivity over the parent strain, were selected for further development.

Strain development involved a study of the nutrient media used for the growth and utilization of the biosensors. The nutrient formulations

used in the activating fluid and the cartridge matrix has a definite effect on the sensitivity and longevity of the biosensors. Various chemical supplements were evaluated for their affect on the sensors. Most of the nutritional study concentrated on preferred nitrogen and carbon sources. In conjunction with nutritional supplements, some chemical buffers were also evaluated.

Sensitivity determinations were conducted on the developed biosensors under laboratory and field conditions. These determinations served to gauge the reliability of the sensors in their ability to detect narcotics or explosives in the field. Some of the field evaluations were conducted independently by the New York City Police.

A biosensor package was designed and put into practical use, which provided ease of handling in the field. The biosensor package included lyophilized sensor pellets, activation fluid and cartridge. The biosensor cartridge was reduced in size to minimize power requirements in the detector device. This in turn made it possible to design and manufacture a smaller, lighter, portable field unit with a complete environmental control system.

The Engineering activities consisted of designing and fabricating two sets of deliverable hardware: (1) breadboard units, which served as test beds for instrument development; (2) prototype units, into which were incorporated the desirable design parameters obtained from the breadboard evaluations. The prototype units were subsequently used for the New York City Police Department field evaluations.

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Initial steps were taken to screen all of the stock cultures maintained in the RPC repository against the vapors of heroin, cocaine, marijuana, dynamite and black powder. Although this screening procedure had been applied in previous contractual efforts (C-45381 and C-41714), it had not included cocaine. Also, new wild strains had been collected and isolated, which had not been tested with any of the vapors of interest.

Screening procedure

All the bacterial strains were screened on one of two multi-chamber laboratory apparatus. Both instruments allowed for six biosensors to be tested simultaneously. One of the instruments (Figure 1) was designed and built under contract to the New York Police. The biosensor chambers were designed to handle cartridges prepared from small petri plates (35 x 10 millimeters). Each channel could be adjusted at flow rates of 0.5 liter per minute (lpm) to 5 liters per minute. The second six-chamber unit built under a different contract was designed to operate at a lower flow rate, in order to utilize the 2-milliliter (ml) beaker cartridges. This unit has an adjustable flow rate range of approximately 0.2 lpm to 1.0 lpm per channel.

Both of these units were equipped with the necessary optical components and electronic circuitry to monitor any change in biosensor luminosity. The changes in the light output of the luminous cultures were recorded on strip

FIGURE 1.

Multi-Chamber Laboratory Apparatus

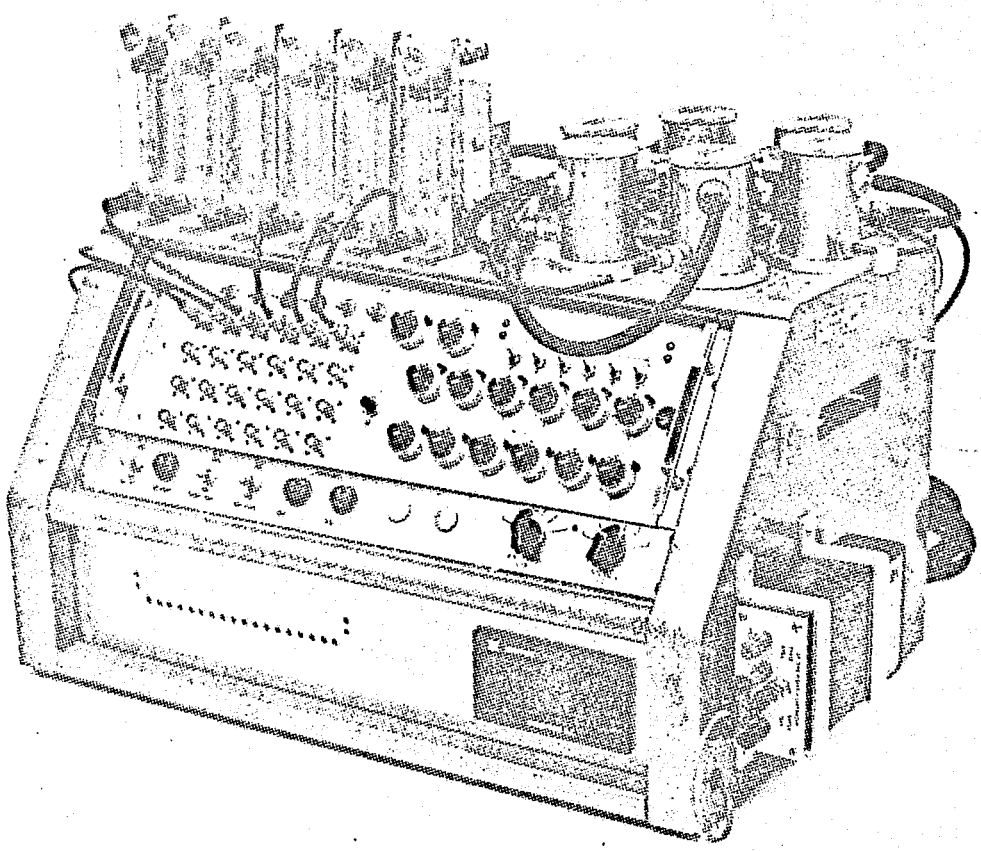


chart recorders (Clevite Brush, Mark 260). Throughout the rest of this report, the responses of the biosensors to the chemical entities, will be denoted as: (1) negative response, which is a decrease in luminescence; (2) positive response, which is an increase in luminescence.

Once the biosensor cartridges were prepared and placed in the instrument, they were allowed to stabilize at the desired flow rate. The individual channel voltage gains were adjusted so that the output voltage (range of 0 to 14 volts), a measure of luminosity, was approximately 4 volts. The chart recorder was actuated and ran at a chart speed of 1 millimeter per second (mm/sec). The chart sensitivity was set at 500 millivolts per division (mv/div). The test narcotics and explosives were placed inside plastic containers (capacity of 1500 ml), which were capped with plastic lids (contained two sampling ports). The vapors of the test materials were allowed to equilibrate and then sampled by inserting the instrument's inflow tube (probe) approximately 0.5 inches inside the container through the sampling ports. In this manner, the biosensors were exposed to the test vapors for one second and/or five seconds. The response of the biosensors to the vapors were recorded and noted for: (1) voltage amplitude; (2) polarity (negative or positive); (3) rapidity. These signal characteristics were used as criteria for evaluation of the biosensor's sensitivity.

Collection and evaluation of wild strains

New strains of biosensors were periodically collected and added to the RPC stock culture collection. The bacterial strains were isolated from water samples taken from various Southern California Beaches. Other strains

were obtained by swabbing the skin surfaces of different marine life (squid, eel, herring, bonito). The marine life that was sampled for luminous bacteria, was bought at fish markets or obtained from the cache of fishing boats. Table 1 lists bacterial strains collected and their sources of isolation.

The specimens collected from all these sources were brought to the RPC laboratories where they were placed in squid nutrient broth and allowed to propagate for 24 to 48 hours at 68° Fahrenheit (F°). The bacterial growth from these broth cultures were streaked on squid and luminous nutrient agar plates (100 x 15 millimeters). This plate streak method of inoculation facilitated the separation of different morphological colonies, i.e. luminescent and non-luminescent strains. The luminescent strains were selected from the nutrient agar plates and isolated into various formulations of nutrient broths. The organisms were allowed to grow in the broths for 24 hours at 68°F. At the end of this period, aliquots of the broth cultures were used to prepare biosensors, to test for their reactions to the chemical vapors of interest.

This collection and evaluation process yielded three strains which reacted to heroin vapors. These particular biosensors produced detection signals of negative polarity (Fig. 2). Prior to this, all of the heroin detections had consisted of positive signals. One of these three new sensors also responded to marijuana vapors with a negative signal. These biosensors were evaluated in the strain development phase to establish parameters for their reliability, longevity and increased sensitivity.

TABLE 1.

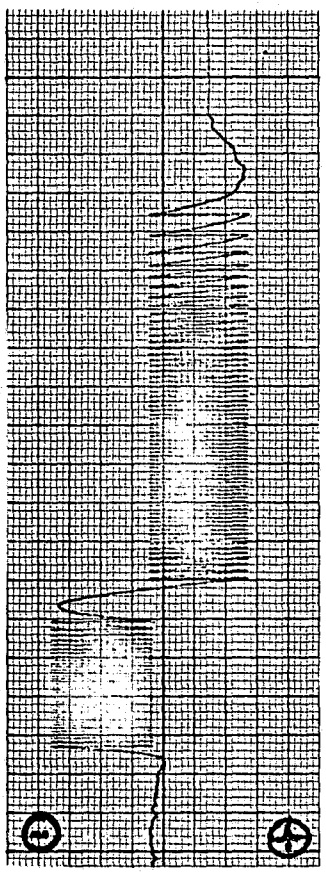
Collection Areas and Sources of Luminescent Strains

Strains Isolated	Source of Isolation	Areas Collected/ California
8 strains	mud, sand and sea water samples	Playa del Rey Marina del Rey
2 strains	Anchovy	Pier at Malibu
2 strains	Tom Cod	Pier at Malibu
4 strains	Shiner Perch	Pier at Malibu
2 strains	Bonito	Harbor at Oxnard
1 strain	Herring	Pier at Malibu
1 strain	sea water	San Clemente
5 strains	Red Rock Cod	Dana Point
1 strain	water sample	Encino
2 strains	Blacksmith Perch	Shelter Island Pier, San Diego
2 strains	Shiner Perch	Dana Point
3 strains	water sample	Shelter Island, San Diego
2 strains	water sample	Cordiff by the Sea

FIGURE 2.

Negative Heroin Sensor

(Wild Strain)



Notes:

1. Electronic mode was rate reset.
2. Chart recorder was set at:
   sensitivity - 500 mv/div., and
   speed - 1 mm/sec.
3. Exposure time to heroin vapors was 5 seconds.
4. Flow rate of detector unit was 1 liter/minute.

Evaluation of stock cultures

The stock cultures from the RPC Collection were tested for sensitivity in a similar manner as the wild strains, but the preparation method was different. The stock cultures are maintained in a lyophilized (freeze-dried) state, which provides a means of indefinite culture storage. In order to prepare sensors for sensitivity screening, the freeze-dried pellets had to be reconstituted in nutrient broths (squid and luminous standard). The introduction of the pellet into the broth reactivates the metabolic processes of the bacterial cultures. These broth cultures were incubated at 69°F for forty-eight hours, at which time, adequate growth and luminescence were obtained to prepare biosensor cartridges for the screening tests.

Aliquots of the broth cultures were transferred by sterile pipette or loop to the nutrient agar surface of petri plates and/or beakers. After twenty-four hours of incubation (69°F), the biosensor cartridges were placed in the laboratory test instrument and evaluated for sensitivity to the vapors of all the test narcotics and explosives.

These screening tests gave rise to biosensor strains, which reacted consistently to heroin and dynamite vapors. A few strains responded slightly to black powder, marijuana and cocaine vapors. All of these strains were subjected to the mutagenic and the nutritional phases of the program in an attempt to enhance and stabilize their respective sensitivity.

STRAIN SELECTION BY MUTAGENESIS

The objective of strain selection was to obtain bacterial sensor strains, which were highly sensitive to the vapors emitted by narcotics and explosives. A successful method, that was utilized for accomplishing this objective, was the technique of mutagenesis. This technique involves disruption of the hereditary mechanisms of the bacterial cells by chemical or physical mutagenic agents. These mechanisms determine the morphological and physiological characteristics of the cell. The primary control center for bacterial physiological characteristics resides in the structural integrity of the DNA (Deoxyribonucleic acid) molecule. By altering the DNA molecule, it is possible to increase the sensitivity and specificity of the biosensors to most chemical vapors. The mutations, that result from the treated biosensors to most chemical vapors. The mutations, that result from the treated biosensors, may also be the reversal of the one characteristic desired; this may be a decrease in sensitivity or even the loss of sensitivity.

The strains that were selected for exposure to the mutagenic agents, had exhibited some degree of sensitivity to the vapors of interest in the preliminary screening tests.

Chemical Methods

The chemical mutagens utilized in this program were: (1) Hydracrylic Acid Beta-Lactone (Beta-Propiolactone $C_3H_4O_2$) which acts on the DNA molecule by causing the formation of defective compounds with purines and pyrimidines;

the Beta-Propiolactone was added to a 3% saline solution to formulate a 0.2 percent concentration of mutagen; (2) Caffeine, a mutagenic trimethylated purine, is not chemically incorporated into the DNA molecule, but disrupts normal rates of nucleic acid metabolism by inhibiting the enzymes producing the nucleic acids. Additionally, caffeine inhibits the normal repair mechanisms for damaged DNA; Caffeine was prepared in a 1% concentration with a 3% saline solution; (3) Caffeine/DMSO was a 1% caffeine solution which contained 10% Dimethyl Sulfoxide (DMSO). The function of the DMSO was to increase the permeability of the microorganism's cell membrane to the caffeine molecule and readily increase chemical action; (4) N-Methyl-N^1-nitro-N-nitroguanidine (MNNG), attacks DNA by causing point mutations with every known basepair in the DNA molecule. This mutagen was prepared and used in concentration of 500 micrograms/milliliter (µg/ml); (5) Rifamycin B ($C_{39}H_{49}NO_{14}$), inhibits enzymatic activity for the production of DNA. This mutagen was prepared by dissolving 1 milligram (mg) per 1 milliliter (ml) of 3% saline; (6) 2-aminopurine which substitutes for adenine (nucleic acid) in DNA formation. It was prepared in the same concentration as Rifamycin (1.0 mg/1 ml); (7) Ultraviolet Radiation, a high-energy radiation affects the DNA molecule by dimerization of Thymine (nucleic acid). Table 2 is a list of chemical mutagens used in these experiments.

The methods of exposing sensor strains to chemical mutagens, 1 through 6, involved the following: aliquots (1 ml) of the nutrient broth cultures were inoculated into 4 ml of the chemical mutagen for exposure time periods of 10 minutes to forty-one hours. At regular intervals, samples of the

TABLE 2.

Chemical Mutagens

Mutagen	Chemical Formulae
2- amino purine nitrate	$C_5H_5N_5NO_3$
beta propiolactone	$C_3H_4O_2$
bromouracil	$C_4H_4N_2O_3Br$
caffeine (dimethyl sulfoxide)	$C_8H_{10}N_4O_2$ $(CH_3)_2SO$
camphor	$C_{10}H_{16}O$
chlorenil	$C_6O_2Cl_4$
di-ethylsulfate	$(C_2H_5)_2SO_4$
nitrogen mustard	$CH_3N(CH_2CH_2Cl)_2$
nitrosoguanidine	$C_2H_5N_5O_3$
rifamycin B	$C_{39}H_{49}NO_{14}$
ultraviolet rays	

exposed sensors were transferred to nutrient agar plates with an inoculating loop. Control samples, which had been exposed to a 3% saline solution without the mutagen, were also transferred to nutrient agar plates. The inoculated plates were incubated at ambient conditions of 70 degrees Fahrenheit (F°) and 60 percent Relative Humidity (%RH). These plates were observed for growth and luminescence at the end of 24 and 48 hours of incubation. Any growth colony which had a different morphological appearance (size, degree of luminescence) from the control colonies, was selected from the plate with a straight nichrome needle and isolated into a nutrient broth. The nutrient broths were observed for luminescent growth and then used to prepare biosensor cartridges (2 ml beakers of petri plates) which were then screened for sensitivity against the vapors emanating from the materials of interest. See Figure 3 for a schematic representation of the mutagenesis procedure.

One of the mutant strains obtained from exposure to Caffeine/DMSO, had a definite improvement of sensitivity to dynamite vapors. The dynamite strain was designated C-70-4. Figure 4 shows a sensitivity comparison between C-70-4 and its parent strain.

A nitrosoguanidine exposed parent strain yielded a mutant with a high degree of sensitivity to heroin vapors. This mutant was designated C-50-8. The parent strain of C-50-8 was a biosensor strain that was also very responsive to dynamite vapors. This biosensor, C-50-8, proved to be of double value, in that, it retained the sensitivity of the parent strain to dynamite vapors and gained the ability to detect heroin vapors. C-50-8

FIGURE 3.

Flow Chart for Mutagenesis Procedure

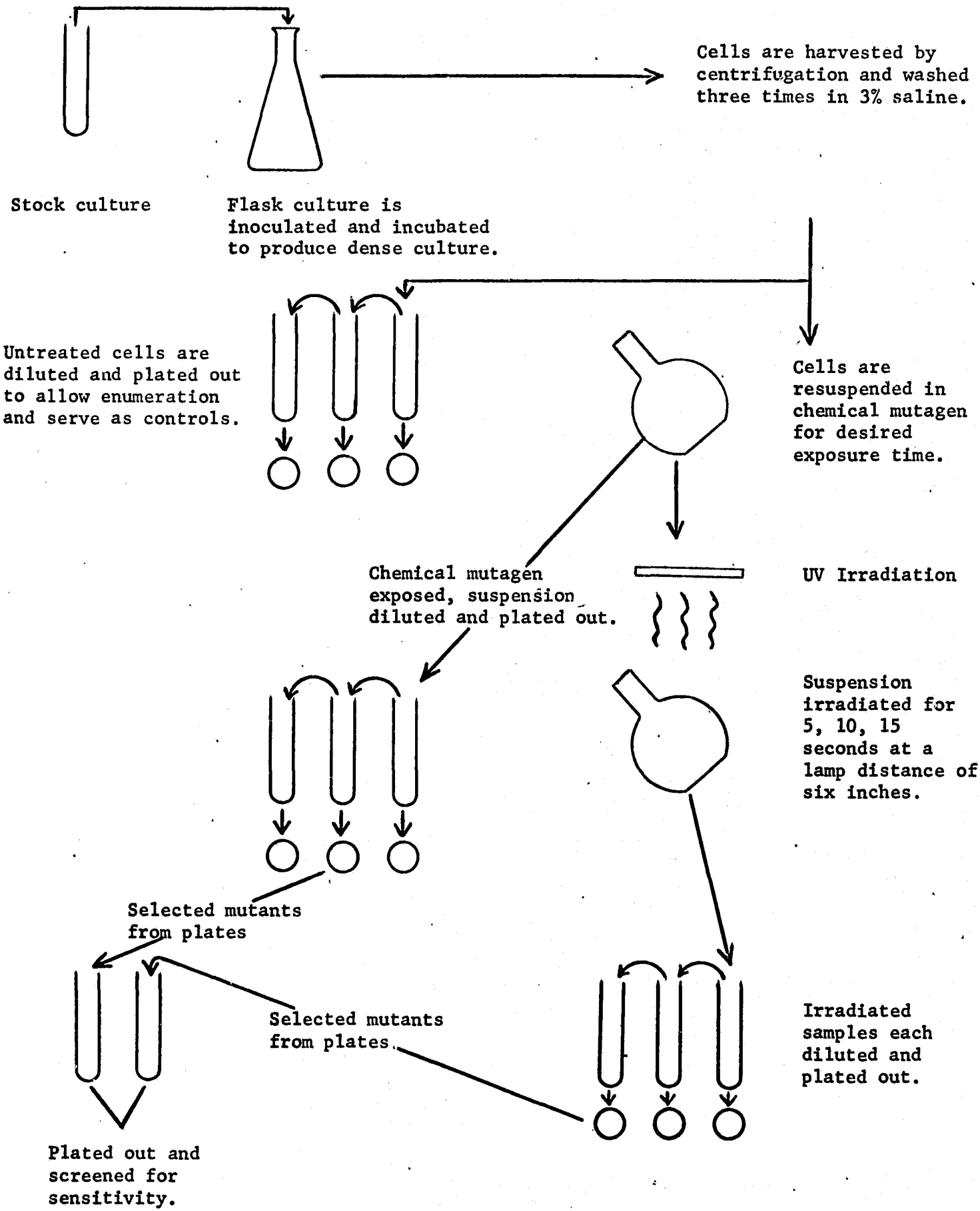


FIGURE 4.

Comparative Dynamite Signals

(Mutant Strain and Parent Strain)

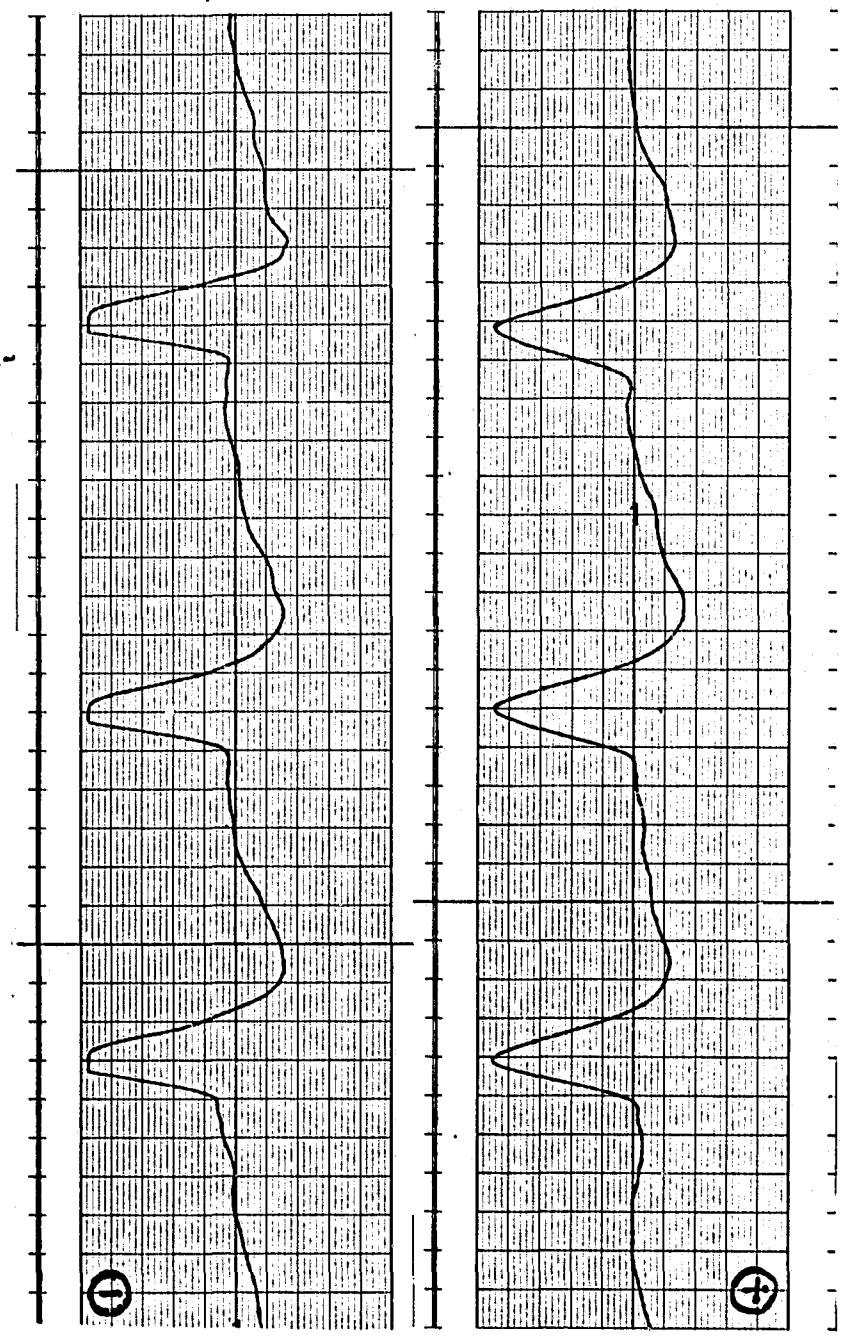
Notes: 1. Mutant was obtained from caffeine/DMSO treatment of strain C-70.

2. Detections were made from a suitcase containing one stick of dynamite.

3. Each strain was exposed 5 seconds to the dynamite vapors.

4. Instrument used was LDU-1 with a flow rate of 3 liter/minute.

5. Chart recorder was set at:
   sensitivity - 500 mv/div.
   speed - 1 mm/sec.



responded to dynamite vapors with a decrease in luminescence (negative signal) and responded to heroin vapors with an increase in luminescence (positive signal).

Through chemical mutagenesis, it was possible to develop a strain with the capability to detect marijuana vapors, consistently. Until this mutant was made available, through mutagenic efforts, a marijuana sensor seemed to be almost non-existent. The mutant was obtained from a strain exposed to Caffeine (1%) for fourty-one hours.

Mutagenesis by ultraviolet irradiation was attempted on various biosensor strains. The experimental biosensors were grown in luminous broth for twenty-four hours. Aliquots of 4.5 milliliters were removed from the broth culture and placed in polyethylene centrifuge tubes. These were centrifuged at 2200 rpm for 12 minutes. The bacterial cells were then washed by resuspension in sterile 3% saline solution. After the second washing, the suspension was exposed to the ultraviolet irradiation (2537A° GE UV tubes, 30 watts) for 1, 5 and 15 seconds at a distance of one meter from the UV source. Immediately after each irradiation exposure, the bacteria were inoculated into luminous standard nutrient agar plates. The inoculated plates were incubated at ambient conditions (68°F, 70% R.H.) in a dark environment for a maximum of five days. Any growth that occurred on the plates which differed morphologically from the control plate was isolated into luminous standard broth. The isolates were left in the broths for 24 hours at 68°F and then plated out on luminous standard plates for sensitivity screening.

The UV treatment produced one mutant strain responsive to marijuana vapors. The parent strain which yielded this mutant, had been exposed to UV irradiation for sixty seconds.

The procedure for UV mutagenic treatment of the biosensors was slightly modified so that the same strain would be repeatedly exposed to the irradiation. It was assumed that multiple and possibly distant mutations might be required to affect the sensitivity and specificity of the biosensors to the vapors of interest. This multiple exposure was utilized on biosensors strains that demonstrated any response to cocaine vapors.

The test cultures were grown for twenty-four hours, diluted 20-fold into fresh nutrient broths, and allowed to propagate for five hours at 70°F. Control experiments indicated that for the strains employed, the viable bacterial cell count increased about 10-fold during the five hours incubation. These broth cultures were centrifuged at high speed in the clinical centrifuge for ten minutes, the resultant pellet was resuspended in sterile 3% saline solution and transferred to a sterile plastic petri plate. The exposed suspension was placed 7.5 inches from the UV source and irradiated for fifteen seconds. Previous control experiments indicated that this treatment decreased the number of viable bacterial cells in the suspension by a factor of 10^4. The cultures to receive further UV irradiation were inoculated into fresh nutrient broth of 10-fold greater volume and allowed to propagate 18 to 24 hours on a shaker. Colonies isolated after each UV exposure were plated at a dilution sufficient to give about 50 colonies per nutrient plate.

The six strains subjected to the multiple UV treatment yielded seventy-two independent isolates, after two cycles of exposure. Each of these isolates and the parent strains were planted on nutrient agar cartridges and tested for sensitivity to cocaine vapors. One isolate (C50C15), the one with the greatest response to cocaine vapors, was derived from strain C-50. A third cycle of UV mutagenic treatment was performed on this isolate. One hundred-eighty isolates were selected after this exposure and tested for detection sensitivity. Five of these were used for further study on the basis of their high response to the cocaine vapors. These five mutants were repeatedly tested for consistency of response to the vapors, as compared to the original mutant. None showed a greater response to cocaine than did strain C50C15. Therefore, it appeared unlikely that further UV treatment would result in increased cocaine sensitivity for strain C50C15. Sensitivity comparisons between the parent strain (C50) and the mutated progeny (C50C15) indicated that the mutant had an approximately 15-fold increase in sensitivity to cocaine vapors.

Physical Method

The inducement of mutants by this method is strictly a physical disruption of the bacterial cells by ultrasonic waves. The probability for the occurrence of a mutation is better when the percentage survival of bacterial cells is less than one percent. A detailed calibration experiment was performed to find the optimal power (watt-seconds) levels for a 99.99% population reduction. The instrument used was a Bronwill Sonifier (Model-Biosonik III).

The calibration test was performed with a heroin vapor sensitive strain. The test strain was grown in a shake flask, which allowed for continuous agitation (aeration) of the broth culture for 36 hours. The aeration increased the number of cells in the culture at a faster rate. The test cells were washed twice and resuspended in sterile 3% saline. This test suspension was divided into 12 equal portions. One portion, used as a pre-sonication control, was diluted and plated to enumerate the initial cell population. Each of the remaining portions was subjected to one of the test parameters, diluted and plated on nutrient agar. All nutrient media used for plating was from the same lot, and all plates were incubated under the same conditions (70°F and 60% R.H.) for 24 hours. Each test sample was plated in triplicate. The bacterial growth of each test plate was evaluated, both for population reduction and evidence of mutagenesis.

Results indicated that power levels of 250-500 watt-seconds were optimal for killing 99.99% of the cells. Table 3 is a tabulation of the results, and indicates good correlation between the same power levels obtained with different time and wattage parameters. The same calibration experiment was conducted with a dynamite vapor sensitive strain. This strain proved somewhat more resistant than the heroin strain and proper population reduction was only obtained with a power level of 500 watt-seconds.

The procedure for exposing all other biosensor strains was similar to the calibration procedure. Several potential mutants were obtained from these tests. The mutants were isolated from the exposed cell growth and assumed to be mutated based on their different morphological appearances, as compared to the unexposed cells (controls).

TABLE 3.

Ultrasonication Survival Studies

Cells/ml Surviving Indicated Power Levels				
Power, % / Time, sec.	minimum	25	50	75
5	3.4×10^8	6.2×10^5	3.3×10^4	Not tested
10	4.2×10^8	1.3×10^4	8.7×10^2	0
20	1.0×10^8	1.1×10^3	6.7×10^1	0

Note correlation between the same power levels obtained with the different time-wattage combinations. The original unsonicated population was 9.5×10^8 cells/ml. All values shown are the mean of 3 samples. 0 indicates no surviving cells.

The isolates were transferred into nutrient broth tubes. When growth and luminosity occurred in the broth tubes, nutrient plates were inoculated and incubated at 68°F and 70%R.H. At the end of 24 hours incubation, the sensors were screened for sensitivity to narcotic's and explosive's vapors.

Of the seven isolates obtained from this study, three initially showed approximately a tenfold improvement in sensitivity to heroin vapors in comparison to the parent strain. Only one of these, however, retained its superior sensitivity.

Combination of Chemical Methods

Experimental procedures were implemented to further increase the potential of mutagenic activity. The biosensors were treated with a combination of mutagens, which involved exposure to Beta-Propiolactone followed by treatment with Ultraviolet irradiation. Each mutagenic agent chemically alters certain sites of the DNA material. Theoretically, the exposure of the biosensors to a combination of mutagens would increase the number of all sites altered and also allow for a larger variety of genetic recombinations.

This first effort at exposing biosensors to a combination of mutagens, produced thirty mutants. The sensitivity evaluations of these mutants revealed that no increase to heroin or dynamite vapors had been accomplished. The mutants were also screened for sensitivity to marijuana, cocaine, and black powder vapors, but none of them demonstrated any reaction to these chemicals.

Combination of Chemical and Physical Methods

The experimental method of producing mutants of increased sensitivity by a combination of exposure to mutagens was continued with treatment of the biosensors with caffeine (1%) and ultrasonics. The experiment was conducted with two strains capable of dynamite vapor detection and two strains that reacted to heroin vapors.

The test strains were washed two times and suspended in a 3% saline solution to eliminate the interference of proteinateous materials, before exposure to the mutagens. Aliquots (15 milliliters) of the washed cell suspensions were added to 15 milliliters of a 1% caffeine solution and allowed to stand for 48 hours. The caffeine-exposed biosensor suspension was then subjected to ultrasonics for 10, 20 and 30 seconds. Immediately after ultrasonic exposure of the biosensors, 0.5 milliliter aliquots of the treated suspension were inoculated on nutrient agar plates (100 x 15 millimeters). These plates were placed at 20° Centrigrade until growth and luminosity were observed (24-120 hours). The growth morphology of these plates was compared to the growth of the control plates (unexposed parent strains). Growth colonies which appeared different (color, size, colony formation) were selected from the media plates and isolated into nutrient broths. A total of 141 mutants were selected from this experimental test. These broth cultures were incubated at 20°C for 24 and 48 hours. At the end of each of these incubation periods, aliquots of 0.5 milliliter were planted on nutrient agar plates (35 x 10 millimeters) and allowed to incubate at ambient conditions (70°F and 60% relative humidity).

When the biosensors had attained growth and luminosity (18-24 hours), they were tested for their reaction to the vapors emitted from heroin, dynamite, black powder, cocaine and marijuana. Of all the mutants screened for sensitivity to vapors of interest, four demonstrated good, reliable detections to heroin vapors. These mutants were evaluated for optimum sensitivity and stability.

STRAIN DEVELOPMENT

Nutritional Studies

The biosensor strains acquired through the mutagenesis phase or any of the other wild and stock strains that demonstrated the ability to detect vapors from narcotics and explosives, were subjected to nutrient studies. The objective of these tests was to establish the nutritional parameters that would aid in optimizing the signal responses of the biosensors and stabilize their reaction to the materials of interest.

The growth, luminescence and detection capability of the biosensor strains may be directly affected by the type of chemical nutrients utilized for their metabolism. Laboratory studies were conducted to evaluate the potential that exists in increasing the sensitivity of the biosensors by alteration of the chemical supplements added to the nutrient media. These studies encompassed the evaluation of: (1) nutrient agar (solid), which is used in the biosensor cartridge; (2) nutrient broth (liquid), which is used to activate the biosensor prior to the preparation of the cartridge. These experimental tests included the evaluation of the chemical sources and the percentages used for compounding of the nutrient media.

The nutritional studies were primarily concentrated in two areas of biosensor cultivation: (1) the nitrogen source, which is supplied to the bacterial sensors in the form of peptones (animal and plant products). The peptones also serve as a source of amino acids and vitamins for the biosensors; (2) carbon source, which is supplemented in the nutrient media in the form of carbohydrates.

The same general procedures were utilized to conduct most of the nutrient studies. The biosensor strains were grown in nutrient broths of different chemical formulations. The strains were kept in the nutrient broths until growth and luminescence were observed (48 hours).

Inocula (0.05 milliliters) of these test broth cultures were then planted on nutrient agar plates, which consisted of varied nutrient combinations. These inoculated plates were used as biosensors after 18 to 24 hours incubation at ambient conditions (70°F and 60%R.H.), and tested for sensitivity against explosive or narcotic vapors. The biosensors were screened on the six-chamber laboratory apparatus, which allowed for a large number of biosensors to be tested rapidly.

Results from the nutrient studies indicated the optimum nitrogen sources for all biosensors, phytone (Baltimore Biological Laboratories) and soy peptone (Oxoid). See Table 4. These two peptones are commercially prepared from soya bean meal. The nitrogen source preferred by the test biosensors in the liquid media (squeeze bottle) was nutrient broth (Baltimore Biological Laboratories). The only biosensor that differed from this preference, was 50-8, the positive heroin sensor. This biosensor exhibited better sensitivity when activated in liquid broth supplemented with phytone. The phytone was added to an ionic solution, which chemically duplicated the internal milieu (fluids) of a marine squid.

To further evaluate and establish the preferred nitrogen source of the biosensors, basic nutrient agar was supplemented with each of eleven

TABLE 4.

Biosensor Peptone Requirements

Vapors Tested	Type Response	Sensor	Peptone Source Required
Heroin	Positive	C-50-8	Phytone
Heroin	Negative	C-117	Soy Peptone
Dynamite	Negative	C-70-4	Phytone
Marijuana	Negative	C-117	Soy Peptone
Marijuana	Positive	C-117	Phytone
Marijuana	Positive	C-50-19	Phytone
Cocaine	Positive	C-50-15	Phytone

amino acids (Table 5). One of these amino acids, arginine, definitely enhanced the longevity of the negative heroin biosensors for detection of heroin vapors. The heroin sensors grown on arginine supplemented nutrient agar could be used for detection operations for up to thirty-five hours. Without arginine, the biosensors sensitivity was good for only two hours. Additional chemicals (peptones and nucleic acids) evaluated in these series of tests are listed in Table 6. The experimental data also revealed, that the carbon source preferred by the biosensors was glycerol ($C_3H_5(OH)_3$) in concentrations of 0.5% to 1.0%. See Table 7 for additional chemicals evaluated as potential carbon sources.

Acidity/Alkalinity Studies

In conjunction with the effects produced by the nutrients, the acidity/alkalinity (pH) range of the nutrient media has also been recognized as an important factor in optimizing biosensor sensitivity. The bioluminescent sensors produce acid (a by-product) as part of their metabolic process and this acid lowers the pH of the nutrient media, which may interfere with the sensitivity of the biosensors. This potential problem may be corrected by the addition of chemical buffers to the nutrient media. The buffers counteract the action of the acid and stabilize the acidity/alkalinity conditions of the media.

Evaluations of organic and inorganic chemical buffers were conducted to determine the optimum buffer to incorporate in the nutrient media used for the propagation of heroin and dynamite biosensors. The organic buffers do not penetrate the bacterial cell membrane; the buffering effect is totally environmental. The inorganic type buffers actually permeate the cell membrane

TABLE 5.

Amino Acids

(Nitrogen Source)

Alanine
Arginine
Asparagine
Aspartate
Glycine
Glutamate
Histidine
Lysine
Methionine
Phenyl-Alanine
Serine

TABLE 6.

Chemicals Evaluated for Nutrient Supplementation

PEPTONES

Biosate - BBL
Casein - BBL
Lactalysate - BBL
Nutrient Broth - BBL
Phytone - BBL
Polypeptone - BBL
Proteose Peptone - DIFCO
Soy Peptone - OXOID
Thiotone - BBL
Trypticase - BBL
Yeast Autolysate - BBL

NUCLEIC ACIDS

Adenine
Cytosine
Guanine
Thymine
Uracil

TABLE 7.

Carbon Sources Evaluated in

Nutritional Studies

alpha-glycerol phosphate
dextrose
d-fructose
d-galactose
d-mannitol
d-sorbitol
glycerol
i-inositol
lactose
maltose
melibiose
raffinose
sodium acetate
sodium pyruvate
sucrose
xylose

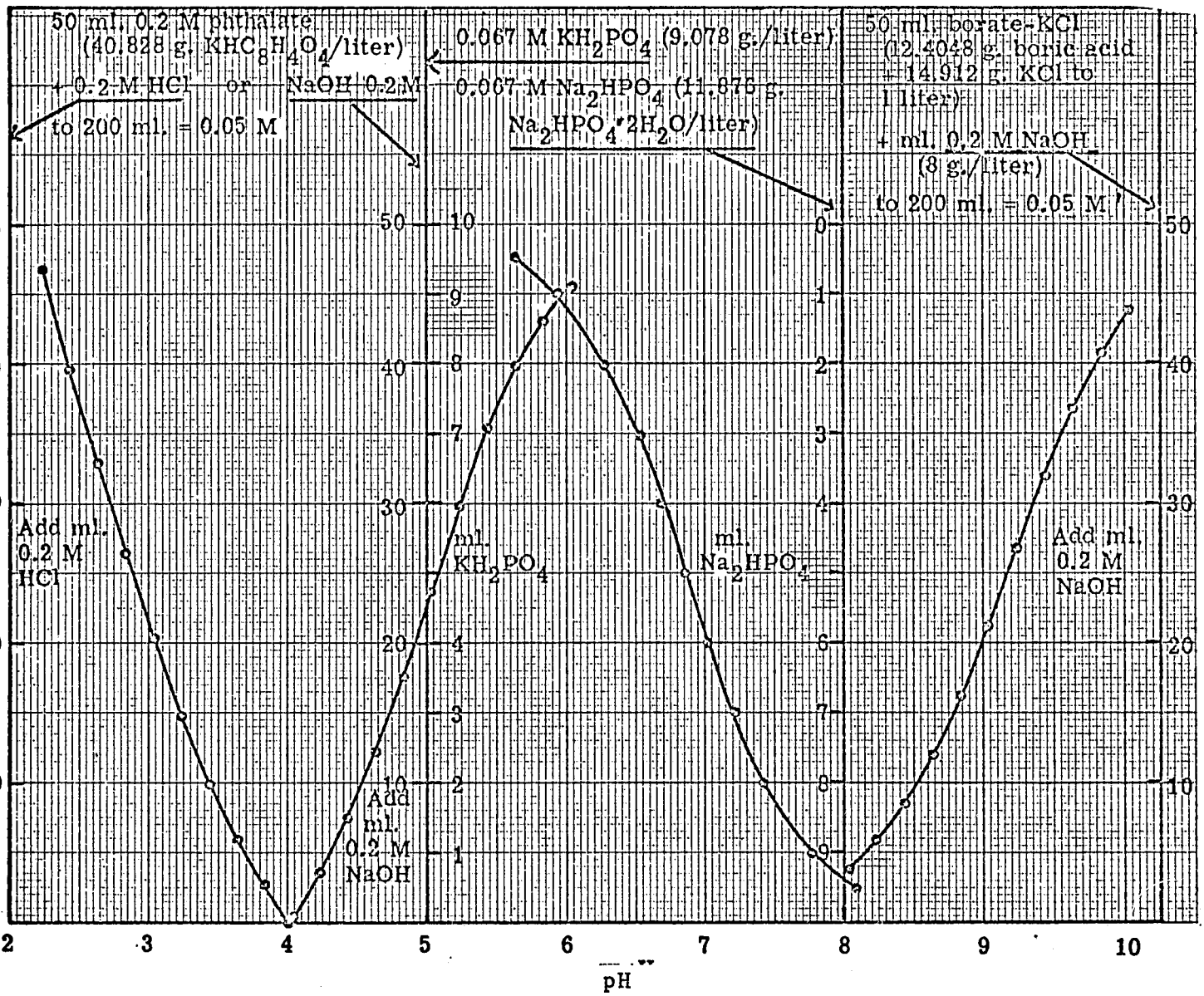
and become part of the cell's chemical make-up (Good, Norman E., et al: "Hydrogen Ion Buffers for Biological Research," Biochemistry, 1966, 5: 467-477). The organic buffers were: (1) 2-amino-2 (Hydroxymethyl) 1, 3-propanediol (TRIS); (2) bis (2-ethane sulfonic acid) monosodium monohydrate (PIPES); (3) N-2-hydroxyethylpiperazine-N-2-ethanesulfonic acid (HEPES). The inorganic buffers consisted of different percentages of formulations of disodium phosphate (Na_2HPO_4), potassium phosphate (KH_2PO_4) and calcium carbonate ($CaCO_3$). These buffers were prepared according to Clark, W.M. "The Determination of Hydrogenious", Williams & Wilkens, Baltimore, Md. 1920. See Table 8.

All of the buffers were individually added to the optimum nutrient agar used for each biosensor. Each of the nutrient agars were divided into separate batches and adjusted to pH levels of 6.0, 6.5, 7.0, 7.5, 8.0 and 8.5. The test biosensors were inoculated on the buffered nutrient agar plates from a forty-eight hour broth culture. When biosensor growth and luminescence were obtained on the nutrient plates (20 hours), they were tested for sensitivity to the chemical vapors of interest.

The results obtained from the acidity/alkalinity series of tests indicated that the positive narcotic sensors and the dynamite sensor reacted best to their specific vapors when grown on nutrient agar buffered with Na_2HPO_4 at a pH level of 8.0. The sensors that responded to marijuana and heroin vapors with a decrease in luminosity were more responsive on nutrient agar buffered with $CaCO_3$. Refer to Table 9 for a list of the organic and inorganic buffers evaluated in these studies.

TABLE 8.

Composition of Buffers



From Clark, W.M. "The Determination of Hydrogen Ions" Williams & Wilkens Baltimore, Md. 1920. Reproduced in. "Manometric Techniques"

Umbriet, W. W., R. H. Burris & J. F. Stauffer; Eds. Burgess Publishing Co. 1964 p. 157

TABLE 9.

Organic and Inorganic Buffers

Organic Buffers

2-amino-2(Hydroxymethyl) 1,3 Propanediol (TRIS)

bis (2-Ethane Sulfonic Acid) Monosodium Monohydrate (PIPES)

N-2-Hydroxyethylpiperazine-N-2-Ethanesulfonic Acid (HEPES)

2-(N-Morpholino)Ethane-Sulfonic Acid (MES)

Tris(Hydroxymethyl)Methylamino-Propane Sulfonic Acid (TAPS)

Inorganic Buffers

Disodium phosphate (Na_2HPO_4)

Potassium phosphate (KH_2PO_4)

Dipotassium phosphate (K_2HPO_4)

Calcium carbonate ($CaCO_3$)

Disodium carbonate (Na_2CO_3)

BIOSENSOR EVALUATION

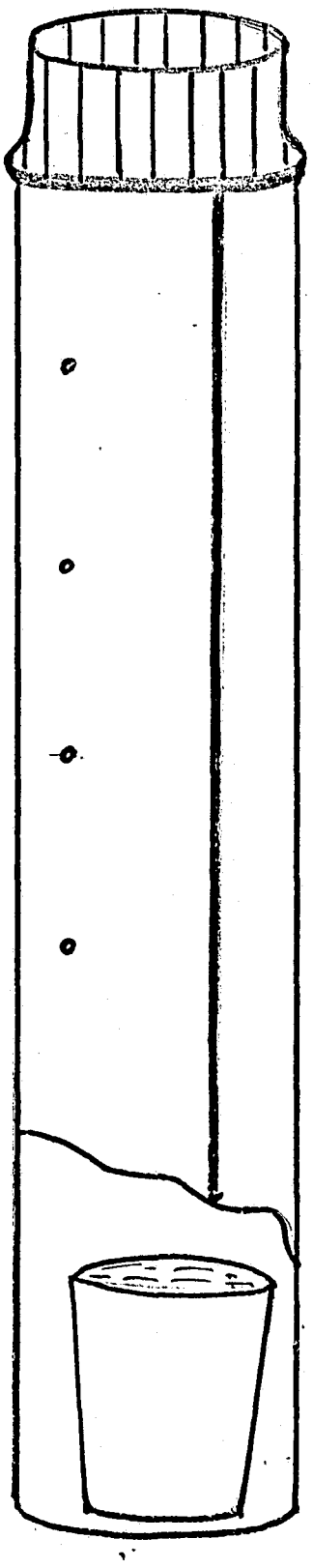
The biosensor strains that demonstrated superior sensitivity to the vapors of interest were retained for further evaluation tests. The objective of these studies was to establish the sensitivity and reliability of the developed biosensors for eventual use in the field. The series of evaluations were designed to simulate field conditions in the search for narcotics or explosives. The dynamite, heroin and marijuana sensors were evaluated in these series of tests. The sensitivities of the black powder and cocaine sensors were not developed sufficiently to warrant sensitivity determinations at this time. The test materials were secreted in different container configurations. All the tests were conducted in the laboratories at ambient conditions. The relative humidity fluctuated between 60 and 70% and the temperature ranged between 66°F and 70°F during the days of testing.

Heroin Tests

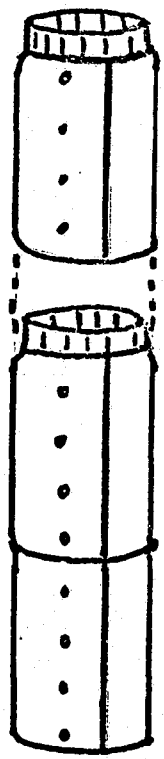
A rapid test for sensitivity determinations was conducted with a chamber assembled from prefabricated sections of standard stove-pipe each 24 inches in length and 7 inches in diameter (Fig. 5). The utilization of this chamber provided the means to test and evaluate the ability of the biosensors to detect heroin vapors at various distances from the source. Figure 6, a typical test, shows the sensitivity of the heroin sensor (C-50-8) to the heroin vapors from a distance of 108 inches. Once the detection capability of the biosensor had been confirmed with the heroin situated in the chamber, the sensitivity evaluation was focused on a simulated cutting room.

FIGURE 5.

Cylindrical Test Chamber



A



B

The chambers are 7" x 54" sections of galvanized steel flue material with 3/16" sampling ports spaced at 6" intervals.

A. shows a section of a cylinder chamber.

B. a miniaturized diagram of how three sections are imposed upon each other in order to achieve desired heights. The open end is covered with a polyethylene plastic liner at the time that the test material is introduced.

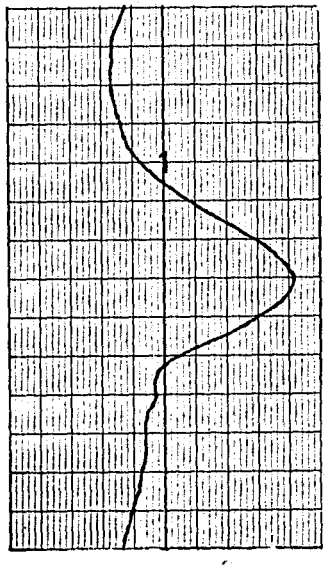
FIGURE 6.

Heroin Signals from Cylindrical Chamber

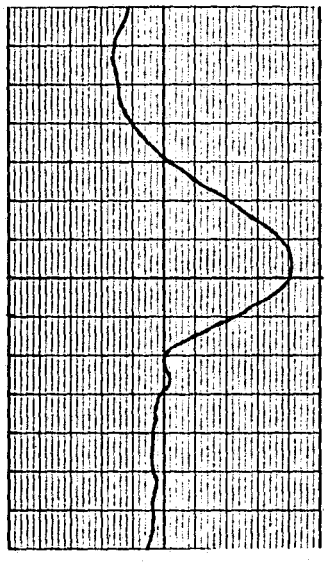
(Strain C-50-8)

Notes:

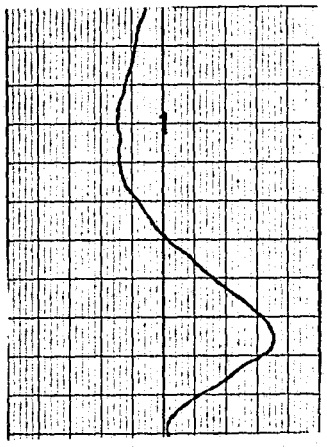
1. Half a kilogram of heroin was used in the chamber and allowed to equilibrate 15 minutes before sampling.
2. Instrument - LDU-1 with gun probe. Flow rate was 3 liter/minute.
3. Chart Recorder set at:
   sensitivity- 500 mv/div.
   speed - 1 mm/second
4. Numbers under signal responses indicate distance sampled above heroin source.



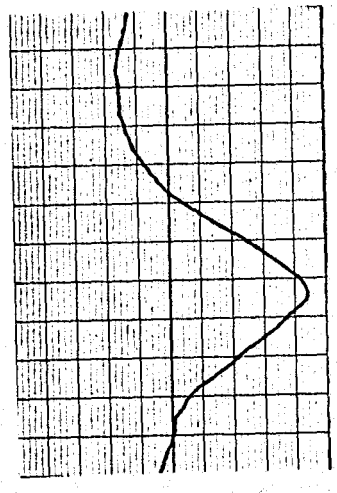
59"



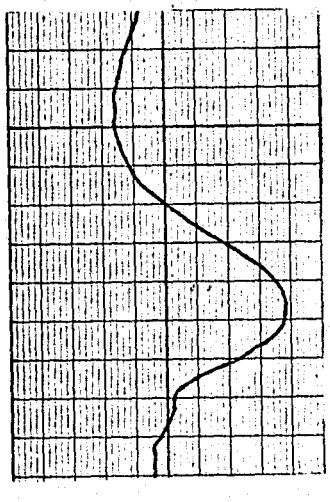
65"



108"



90"



77"

Cutting room

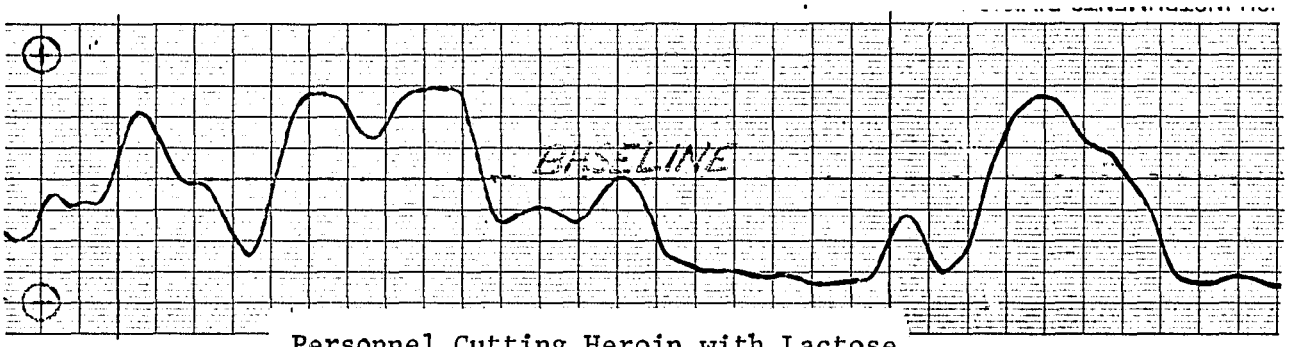
The cutting room was set up in the RPC Building and the detection capability of the heroin sensors was evaluated without controlled laboratory conditions. The room was intentionally cluttered with trash and filth (beer cans, rags, fresh and rotting fruits, a variety of cheeses, urine) in an attempt to mask the heroin vapors. The procedure for the detection of heroin from the cutting room involved testing the room for background interferences which might cause false alarms. The background of the room and actual cutting of heroin was monitored under different circumstances as follows: (1) empty room; (2) three women in room; (3) three women in room filling glasine bags with lactose; (4) three women in room mixing 7 oz. of lactose with 1 oz. of heroin, then filling glasine street bags with this mixture; (5) room was aired out for three days, then two men and one woman filled and emptied the glasine bags. All of these tests were conducted with the windows opened and closed.

All of the room monitoring was done through two sampling ports in the door and the crack under the door. The results obtained from these tests showed that until the heroin was introduced into the test procedure, the biosensor produced a quiet background as indicated on the chart recordings. The biosensor demonstrated quite an increase in background activity and an occasional strong positive deflection, whenever the heroin mixture was worked within the test room. These results demonstrated that it was possible to detect the heroin vapors through the door of a room. See Figure 7 for some chart recordings from these tests.

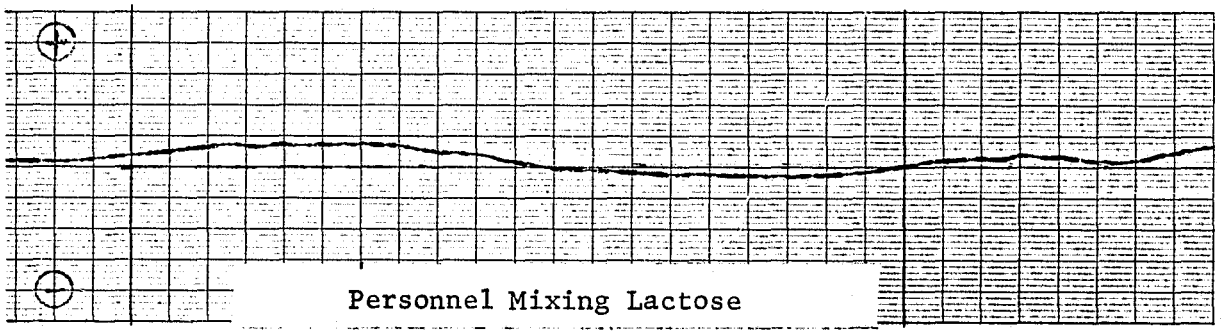
FIGURE 7.

Heroin Signals from Cutting Room

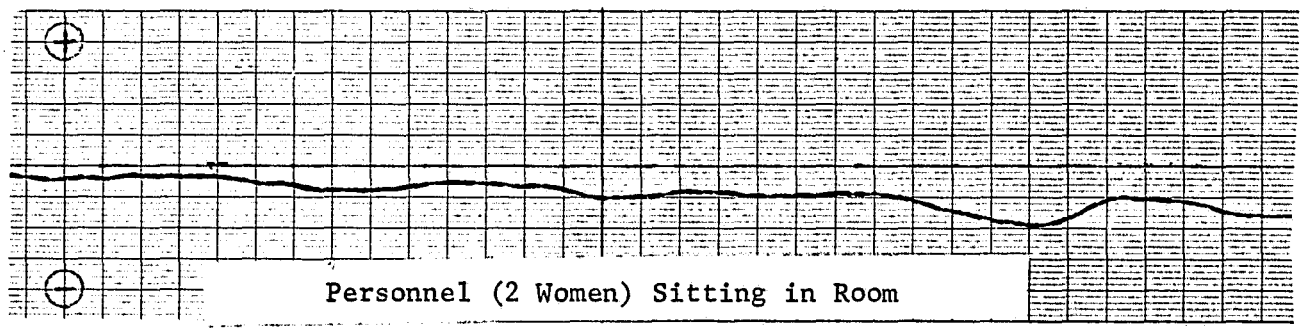
(Composite of Strip Charts)



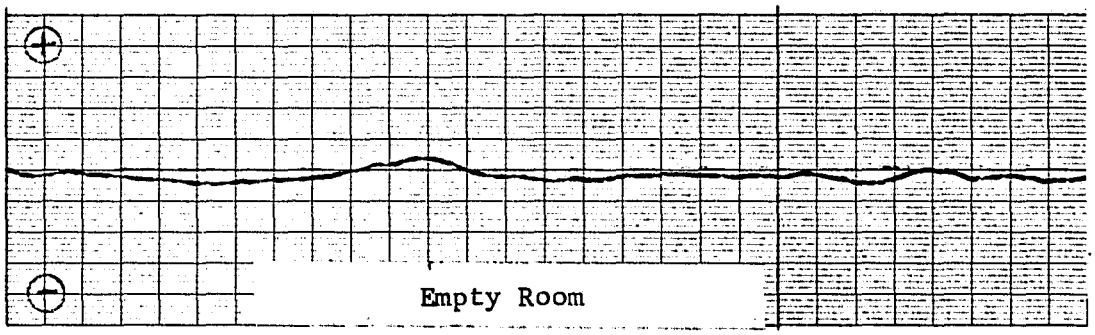
Personnel Cutting Heroin with Lactose



Personnel Mixing Lactose



Personnel (2 Women) Sitting in Room



Empty Room

Wall search

Detections of heroin located inside a wall partition was also attempted. For this test, a panel was removed from a room wall and the package (½ kilogram) of heroin was placed inside. The panel was then nailed back in place. The control was the wall partition next to the heroin site and was separated by a 2 x 4 inch stud. Sampling was accomplished from two holes (0.25 in. diameter) drilled into the wall, one in the heroin partition and one in the control partition. This allowed for sampling of the vapors from each partition. Heroin detections were made from the wall within 10 minutes of placing the heroin in the partition (Fig. 8).

The detection of heroin from a wall was pursued further and entailed the assembly of a portable wall for test purposes. The test wall was built according to specifications based on a test wall built by the New York Police. The wall was built to contain six regulation compartments, separated with 2 x 4 inch studs. The heroin was located in one of the six compartments and the others were used as controls. The amount of heroin used for the wall tests was half a kilogram inside a plastic bag, wrapped in newspaper and sealed with tape. Both the negative and positive heroin biosensors (C-117 and C-50-8) were used in these detection tests. The detector units utilized in the wall tests were: (1) New York breadboard, which did not have a humidifier system; (2) New York prototype, which had an environmental control system.

Detections with the breadboard unit produced some false alarms, which

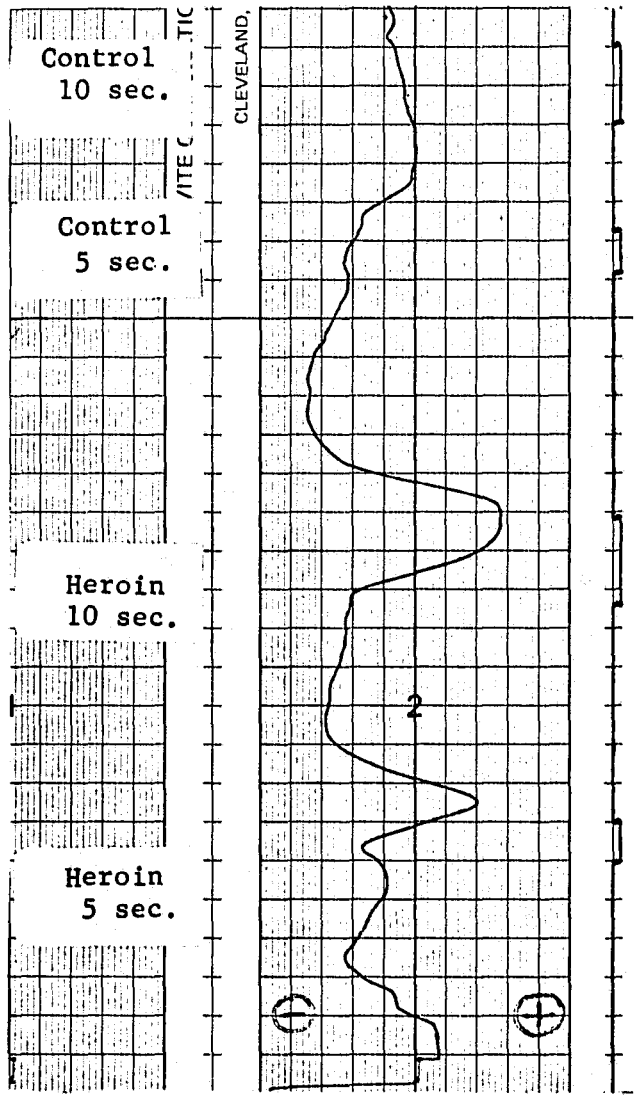
FIGURE 8.

Heroin Signals From

Interior of Wall

Notes:

1. Half a kilogram of wrapped heroin was in wall for 10 minutes.
2. Control partition was separated from heroin partition by a 2 x 4 stud.
3. Time event of exposure time is recorded on right side of chart.
4. Chart speed was set at 1 millimeter/second.
5. Flow rate of detector was set at 3 liter/minute.



interferred with legitimate detection signals. Observation of the biosensor's reactions during these false alarms indicate that the false signals may have been caused by a humidity phenomenon. This fact was proven when the wall heroin detections were conducted with the prototype unit. Consistent heroin signals were made from the wall within an hour of placing the heroin package in the wall (Figure 9).

Foot locker (storage trunk) search

Heroin vapor detection tests were conducted with 4 ounces (oz.) of heroin in a plastic bag located inside a foot locker (12 x 16 x 30 inches). The outside of the locker was marked at seven different reference points and used as sampling sites (a to g). The inside of the locker was marked at nine locations which were used as placement points for the heroin package (Fig. 10). In this manner, the distance between the sampling points and the location of the test material was always known. Each point was sampled three times using the New York prototype unit.

The strains gave strong heroin signals, after the heroin package had been in the foot locker for approximately half hour. The first sampling (5 to 30 seconds) from any point gave reproducible results from all seven sampling points, regardless of where the heroin was located. Figure 11 shows the test results with the negative heroin sensor. It was noted, however, that with each consecutive sampling of the vapors, the signal amplitude diminished and took longer exposure times to obtain (Fig. 12). This was due to the rapid depletion of the heroin vapors.

FIGURE 9.

Heroin Signals from Portable Wall

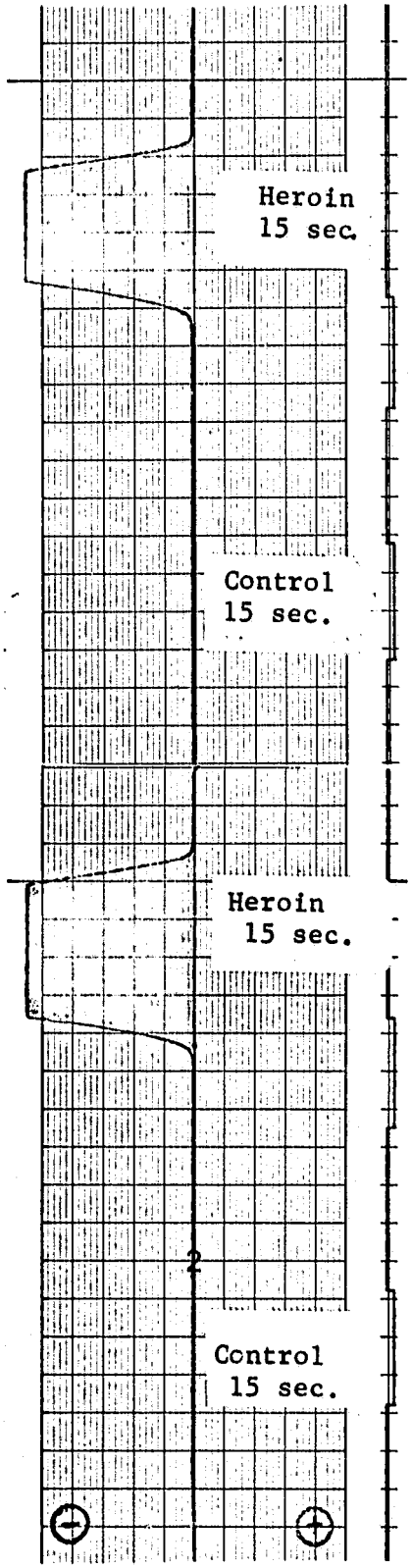
Notes: 1. Chart #A are negative heroin signals produced by sensor C-117.

2. Chart #B are positive heroin signals produced by sensor C-50-8.

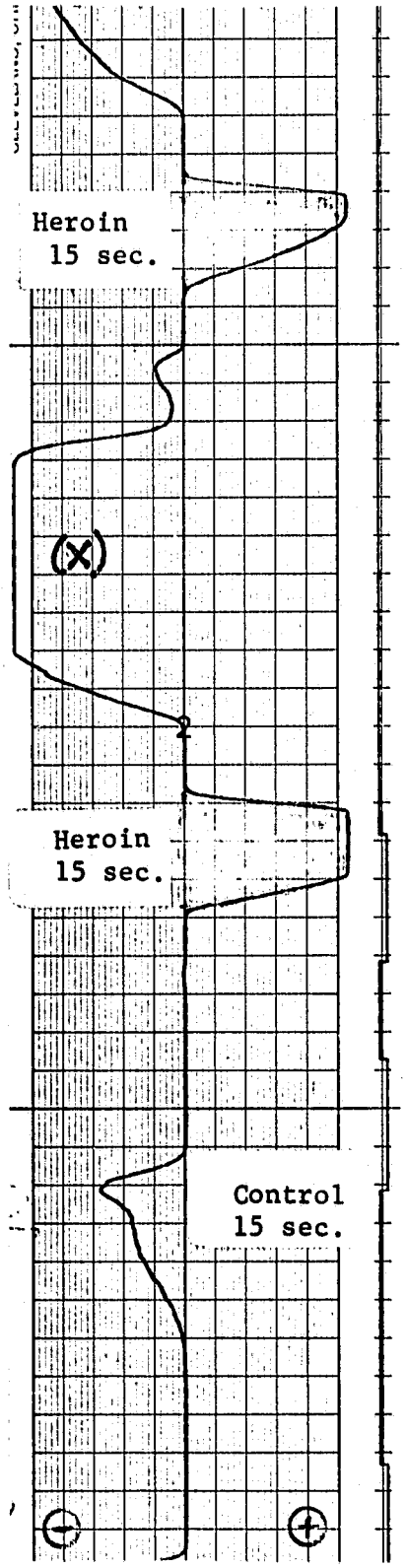
3. All exposures were 10 seconds.

4. Instrument - NY prototype

5. (X) denotes backswing from excessive exposure.



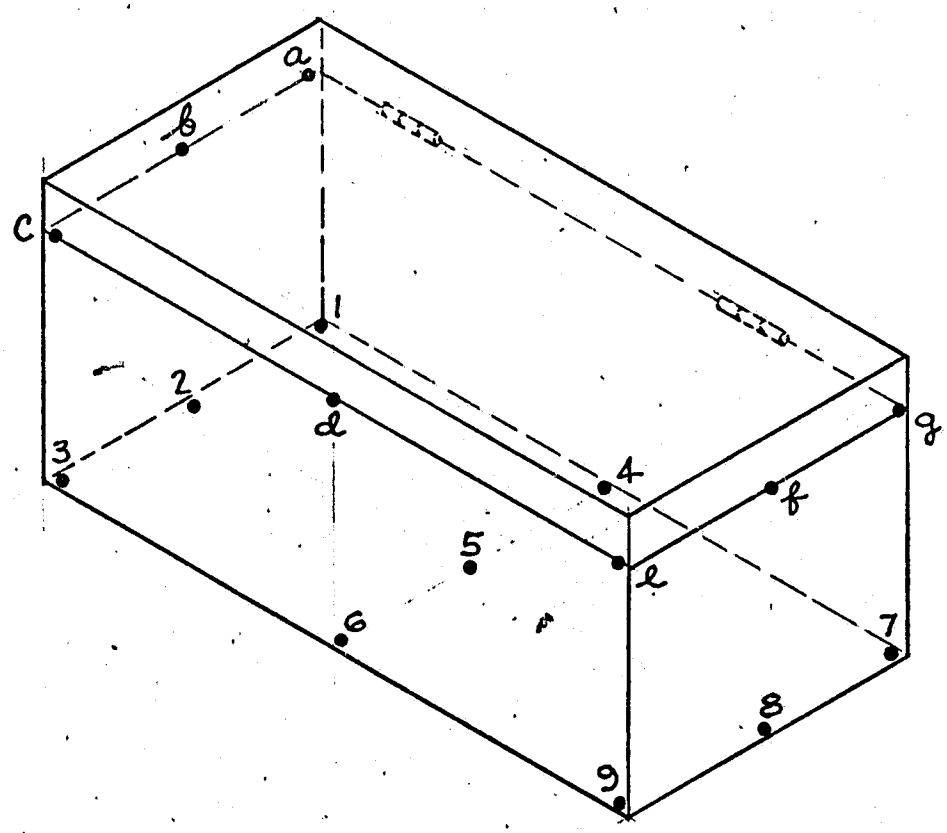
A



B

FIGURE 10.

Foot Locker Used for Heroin Detections

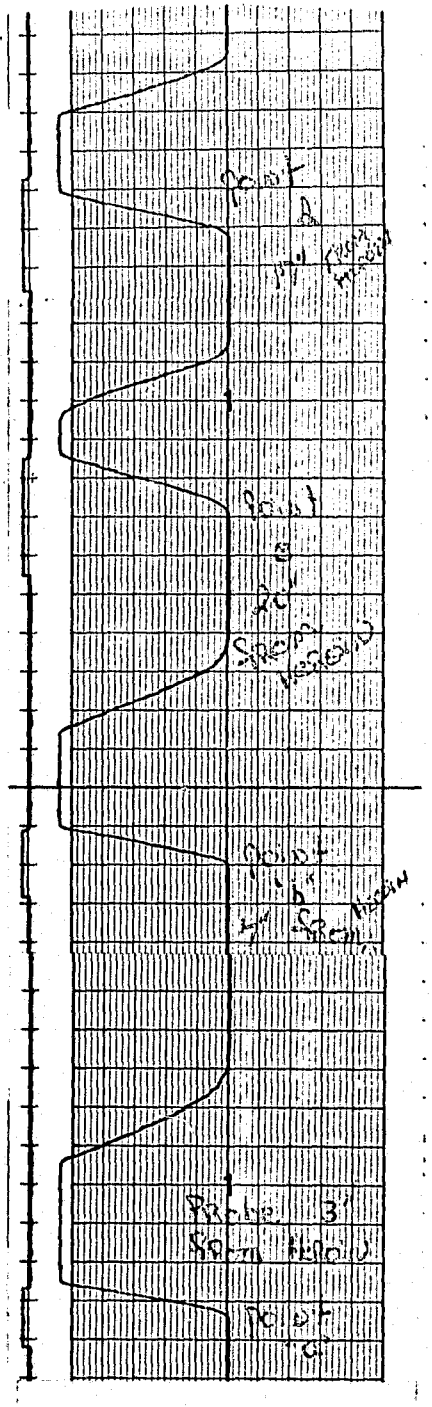


Notes:
1. Sampling points are denoted by the letters a to g.
2. Location sites are denoted by the numbers 1 to 9.
3. Dimensions of foot locker (11 3/4 x 16 x 30 inches)
4. Approximate volume, 3½ cubic feet.

FIGURE 11

Heroin Detection Signals from Foot Locker

Notes:
1. Refer to Figure 10 for key to sampling points.
2. NYC prototype unit was used for these detections.
3. Signals are of negative polarity.
4. Strip charts are composites.

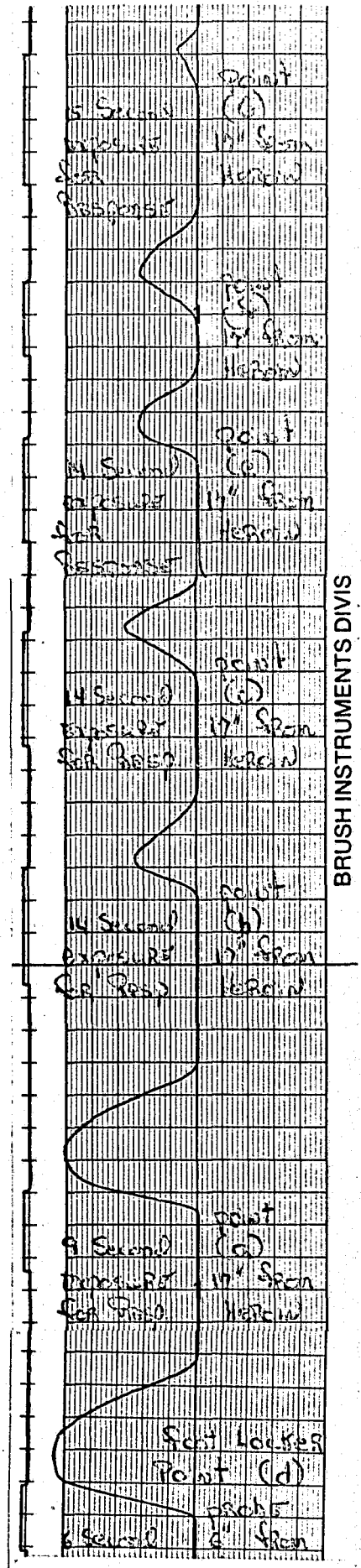


C-117 Replicate #3
FOOT LOCKER
30 min. after placement of HEROIN at point #1

FIGURE 12.

Heroin Detection Signals from Foot Locker

Notes: 1. Same as Figure 11, except dwelling time of heroin was one hour.



C-117 Replicate #5
FOOT LOCKER
1 hour after placement of HEROIN at point #1

Cardboard carton search

A heroin package (4 oz.) was placed in cardboard boxes of various sizes (Fig. 13) and used in continuation of the heroin search tests. Sampling holes were made in the cartons at various intervals from top to bottom, which provided the means of measuring the distance from the detection point to the location of the heroin. The same test procedures were applied for the cartons that were used for the foot locker.

The results obtained from these tests indicated that the sensitivity of the sensors was adequate for the detection of heroin secreted in cardboard cartons. Figures 14 through 16 are representative of some of the test results.

Dynamite Tests

Sensitivity determinations were made with the dynamite sensor (C-70-4) utilizing the same test procedures that were used with the heroin sensors. The initial tests were conducted with the cylindrical chamber and continued into luggage, foot lockers and storage cabinets.

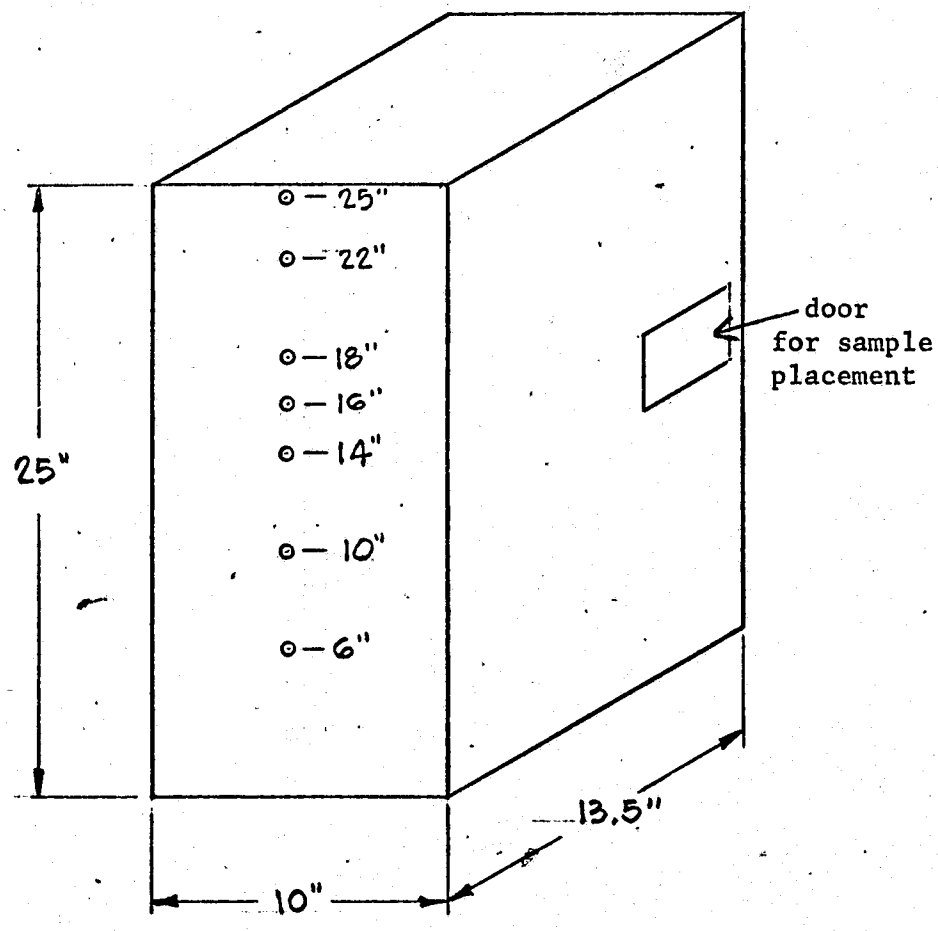
Cylindrical chamber

The sensitivity of the dynamite biosensor (C-70-4) was tested with the dynamite prototype unit against the vapors emitted from one stick of dynamite (Hercol-50%) located inside the chamber. The dynamite stick had a residence time of one hour in the chamber before detections were attempted.

Detection signals were obtained from each sampling point up to 104 inches away from the source, where the sampling was terminated. There was a slight decrease in signal amplitude as the distance increased between the sampling

FIGURE 13.

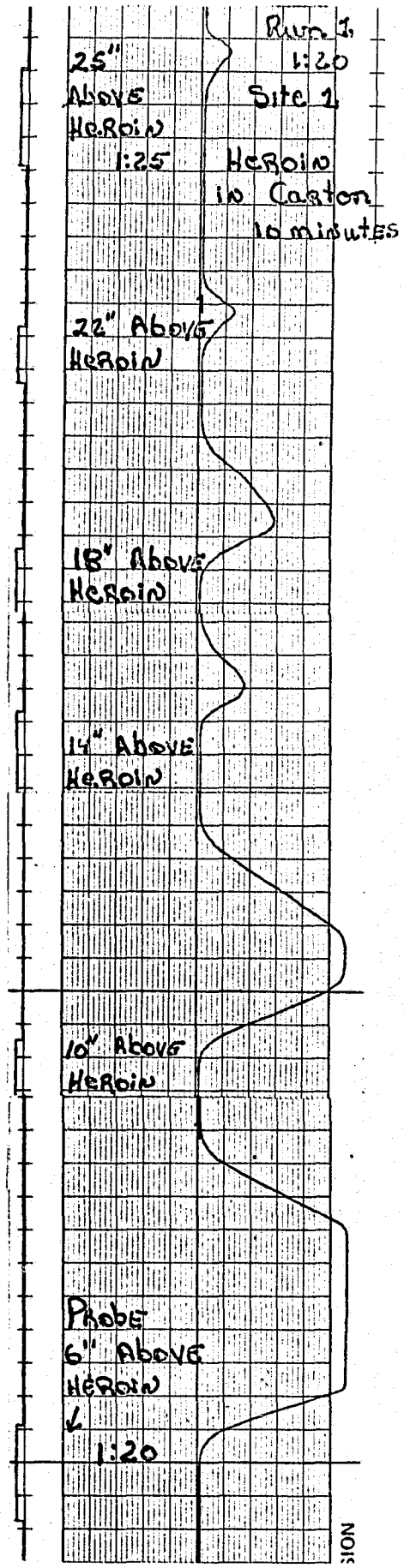
Cardboard Carton Used for Heroin Detections



Notes:
1. Location site was at bottom center of carton.
2. Sampling points are denoted by numbers 6, 10, 14, 16, 18, 22 and 25.
3. Two other cartons were used that had the following dimensions:
   a. 8x8x16 inches
   b. 8x10x18 inches

FIGURE 14.

Heroin Detection Signals from Cardboard Carton



Notes:

1. Refer to Figure 13 for key.
2. Positive heroin strain C-50-8 was used.
3. All responses were of alarm mode.
4. Instrument - NY prototype.
5. Heroin was in carton 10 minutes before sampling vapors.
6. Strip charts are composites.

Figure 15.

Heroin Detection Signals

from Cardboard Carton

Notes: 1. Same as Figure 14, except dwelling time of heroin was 25 minutes.

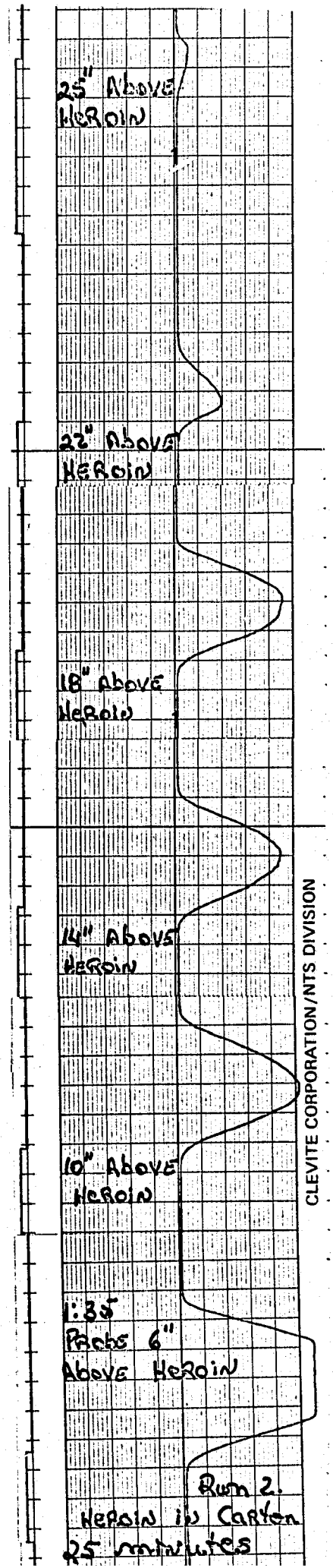
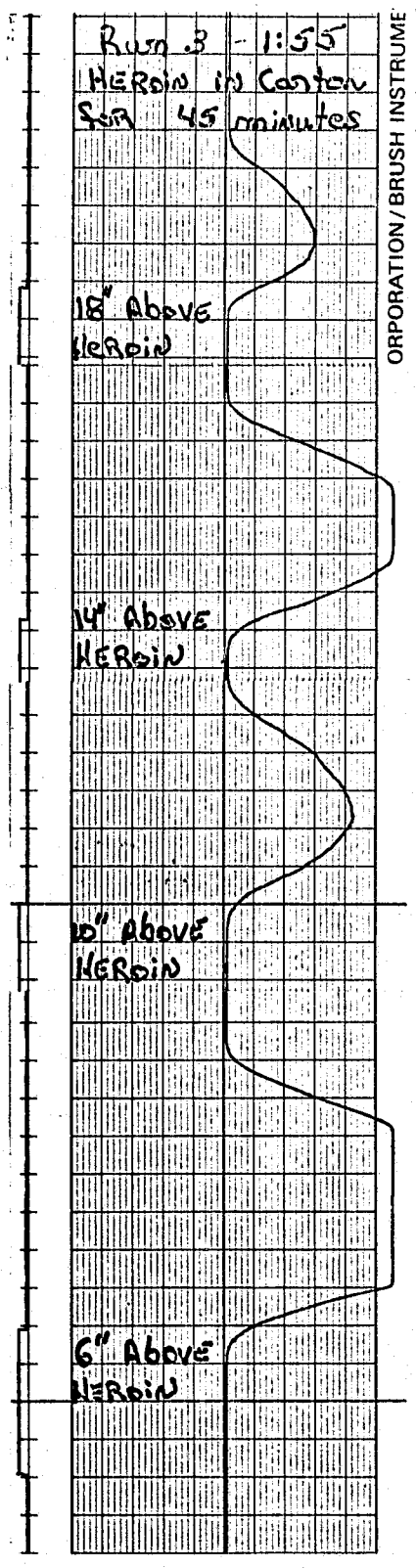


FIGURE 16

Heroin Detection Signals from Cardboard Carton



Notes: 1. Same as Figure 14, except dwelling time of heroin was 45 minutes.

point and the dynamite, but the detection signals were strong enough to permit testing at longer distance. See Figure 17 for some of the test results.

Baggage search

Based on the results obtained from the chamber tests, the sensitivity of the dynamite sensor was further challenged with attempts to detect dynamite secreted in various pieces of baggage. One dynamite stick (Hercol-50%) was placed in a briefcase and two dynamite sticks (Hercol 20% and 50%) in a suitcase. The unit used in these tests was the laboratory detection unit (LDU-1), operated at a flow rate of 3 lpm.

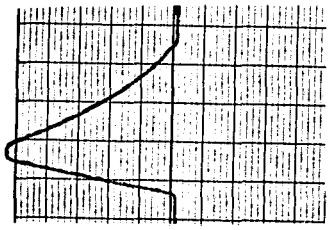
Detections were accomplished in less than five seconds when the probe was inserted approximately one inch into the luggage. Attempts were made to detect the dynamite from closed luggage, but at this time were unsuccessful. Figure 18 is representative of some of the detection signals obtained from this test. The detection of dynamite vapors from closed luggage was attempted again, but this time the detection tests were conducted with the New York Prototype Unit. One stick of dynamite (Hercol-40%) was placed in each of the following; a briefcase, vanity case, and two different suitcases (2-suiter). The dynamite was allowed half hour residence time before attempts were made to detect the vapors through the keyholes or locks. The maximum residence time was one hour total.

Detection alarms were obtained from all the luggage that had dynamite within 7 seconds. The amplitude of the signals obtained, varied due to the volume encountered in each separate piece of luggage. The residence time of the dynamite also contributed to the vapor dilution factor, which caused a

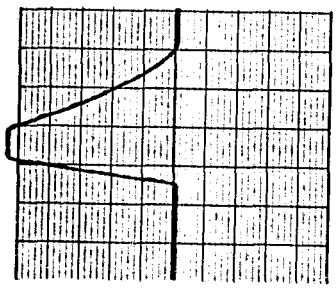
FIGURE 17.

Dynamite Signals from Cylindrical Chamber

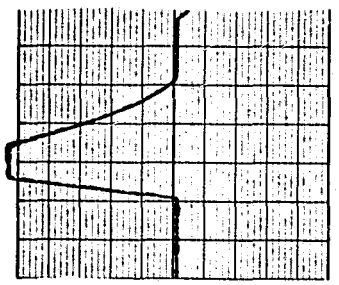
Notes:
1. The biosensor used was C-70-4.
2. Instrument - NY Prototype
3. Chart recorder set at:
   sensitivity - 100 mv/div.
   speed - 1 mm/sec.
4. Dynamite stick was Hercol 50% and was allowed a dwelling time of one hour before sampling vapors
5. Refer to Figure 5.



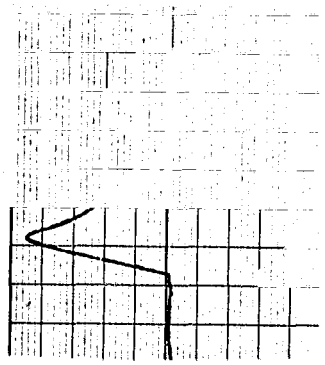
52"



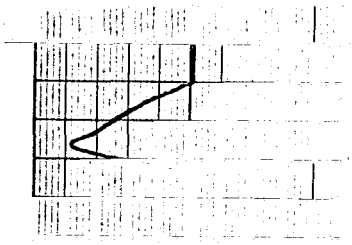
40"



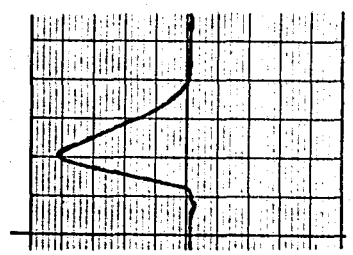
24"



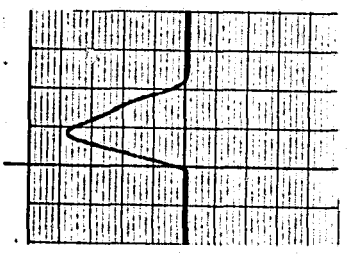
104"



96"



88"



72"

FIGURE 18.

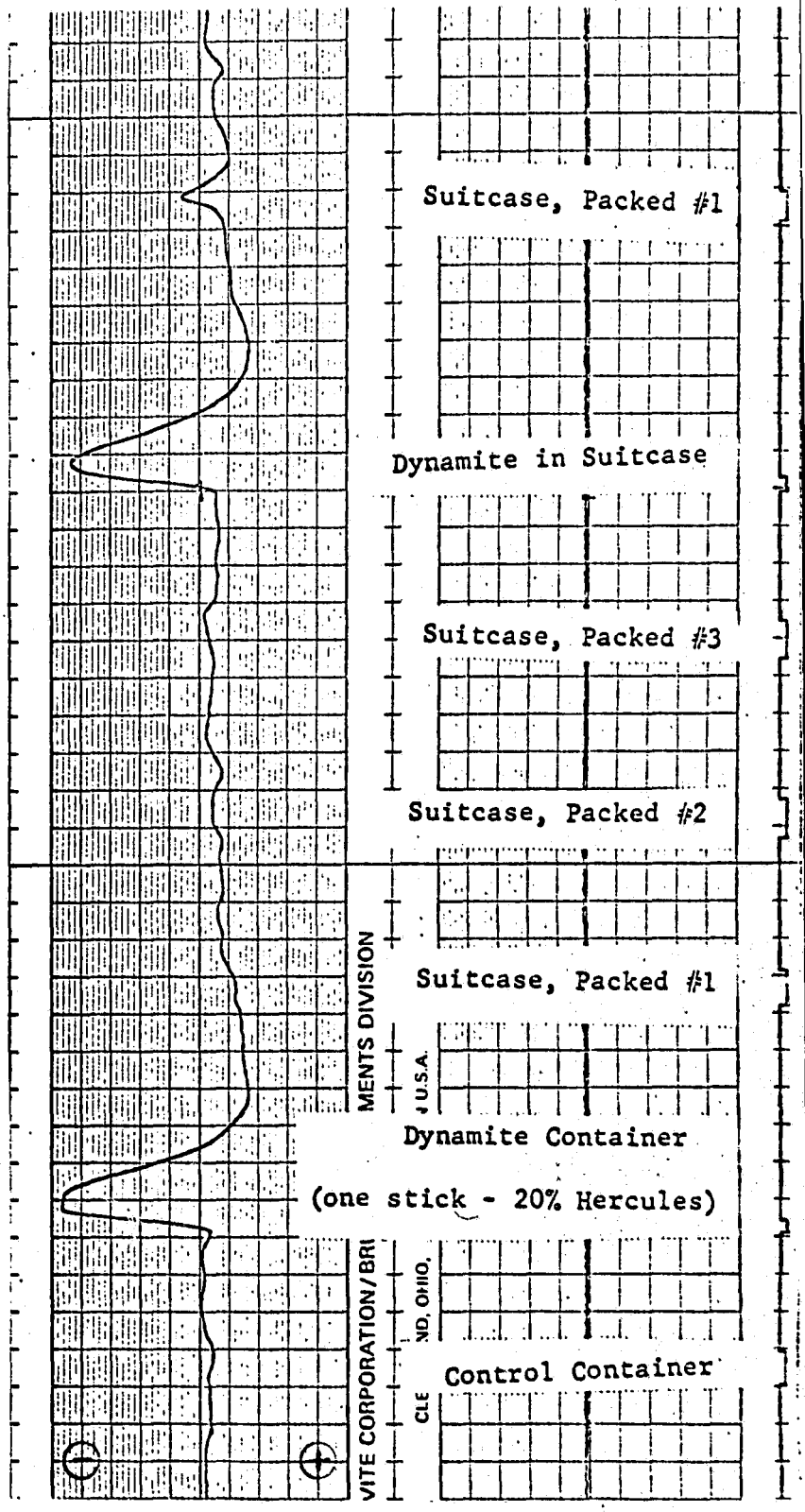
Dynamite Detection Signals

(Open Luggage)

Notes: 1. Biosensor used was C-70-4.

2. Chart recorder was set at:
   sensitivity- 500 mv/div.
   speed - 1 mm/sec.

3. Suitcases #1, 2 and 3 were controls.



difference in signal amplitude. Even though the dilution factors prevented signals of larger amplitude, the biosensors were sensitive enough to overcome them and detect the dynamite vapors. See Figure 19 for some of the test results.

Foot locker search

The procedure used for dynamite search was similar to that used in the heroin search. The locker was marked on the outside at eight sampling points and eight locations were marked on the inside for placement of the dynamite (Figure 20). Each of the sampling points was tested three times, which produced a total of twenty-four trials at each location. The sampling distances ranged from twenty-eight inches to two inches from the dynamite source. The detection signals obtained took an average of two to five seconds to alarm. See Figure 21.

Storage cabinet search

As a further evaluation of sensitivity, the dynamite sensor was challenged with the vapors contained in a large two doors storage cabinet (Fig. 22). The sampling points were located between the doors and cabinet body at the ends of each shelf. The dynamite stick placement sites were located at the center of each of the six shelves. This placed the farthest sampling point at seventy-six inches away from the dynamite stick. The procedure for sampling the vapors was as follows: the dynamite was placed on the first shelf and then progressively moved down to the next shelf. Before the dynamite was moved, each end of all the shelves was tested for dynamite vapors and the cabinet cleared of residual dynamite vapor.

FIGURE 19.

Dynamite Detection Signals

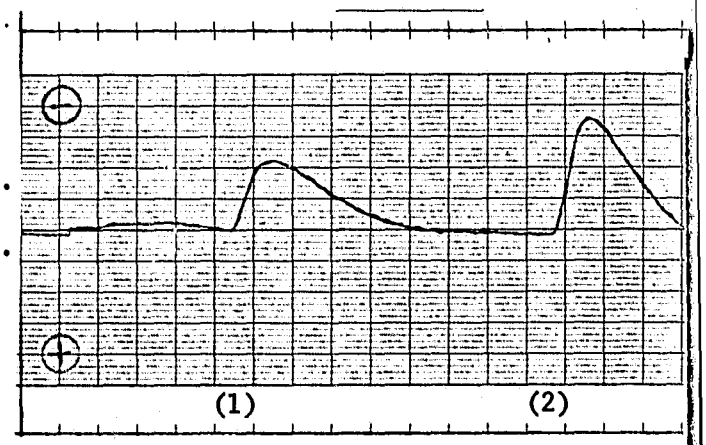
(Closed Luggage)

Notes: 1. Instrument used was NY Prototype.

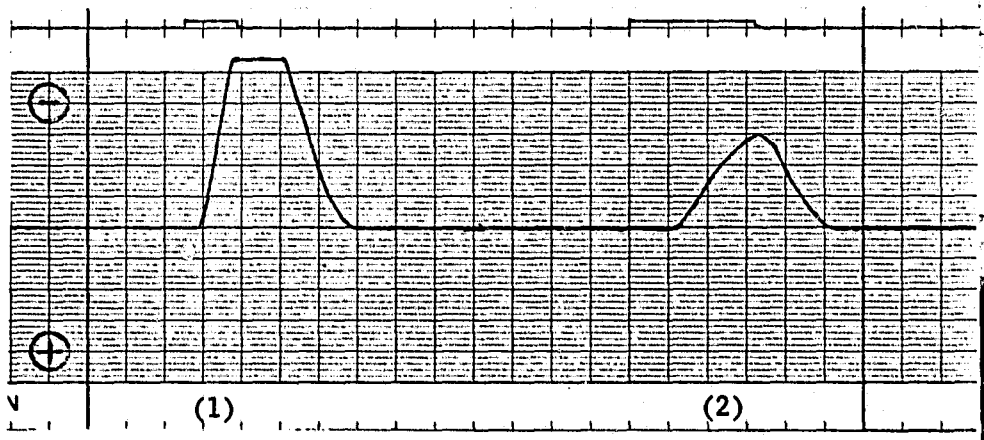
2. Chart A
   (1) Detection from briefcase keyhole. Dynamite residence time ½ hour.
   (2) Detection from briefcase keyhole. Dynamite residence time 1 hour.
   (3) Empty briefcase control.

3. Chart B
   (1) Detection from vanity case keyhole.
   (2) Detection from suitcase keyhole.

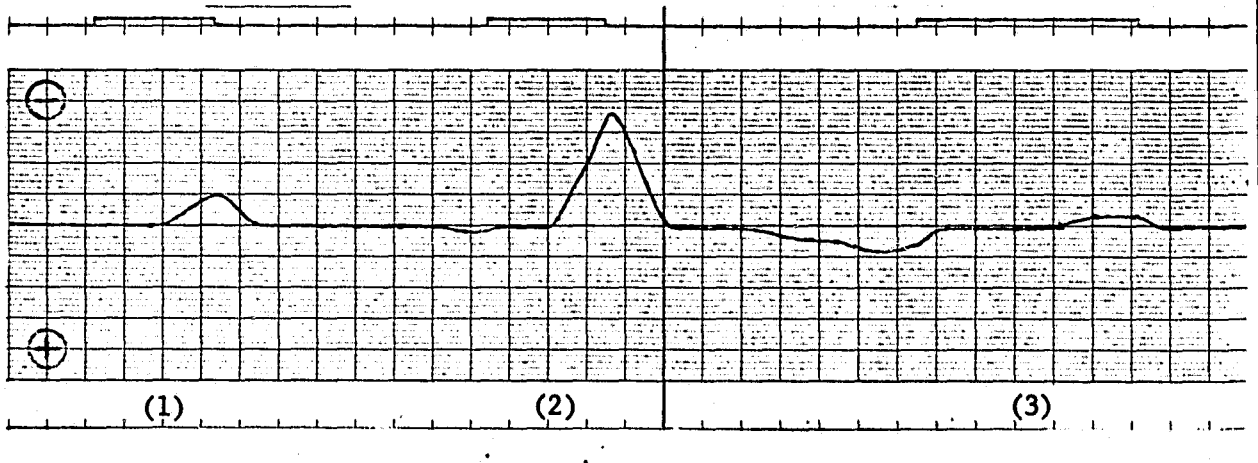
4. Chart C
   (1) Detection from suitcase keyhole
   (2) Repeat of (1).



C



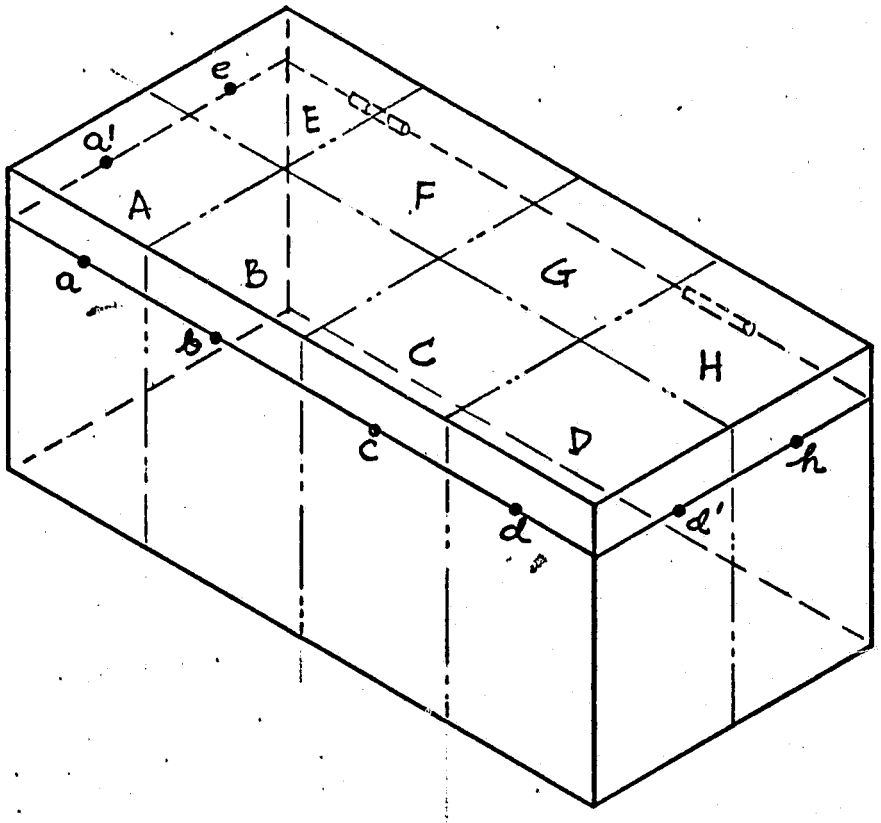
B



A

FIGURE 20.

Foot Locker Used for Dynamite Detections



Notes:
1. Sampling points are denoted by the small case letters a to h.
2. Location sites are denoted by the capital letters A to H.
3. Dimensions of foot locker (11 3/4 x 16 x 30 inches).
4. Approximate volume, 3½ cubic feet.

FIGURE 21.

Dynamite Detections from Foot Locker

Notes:
1. Refer to Figure 20 for key to sampling points.
2. Instrument used was NY Prototype.
3. Strip charts are composites.
4. (X) denotes backswing from excessive exposure.

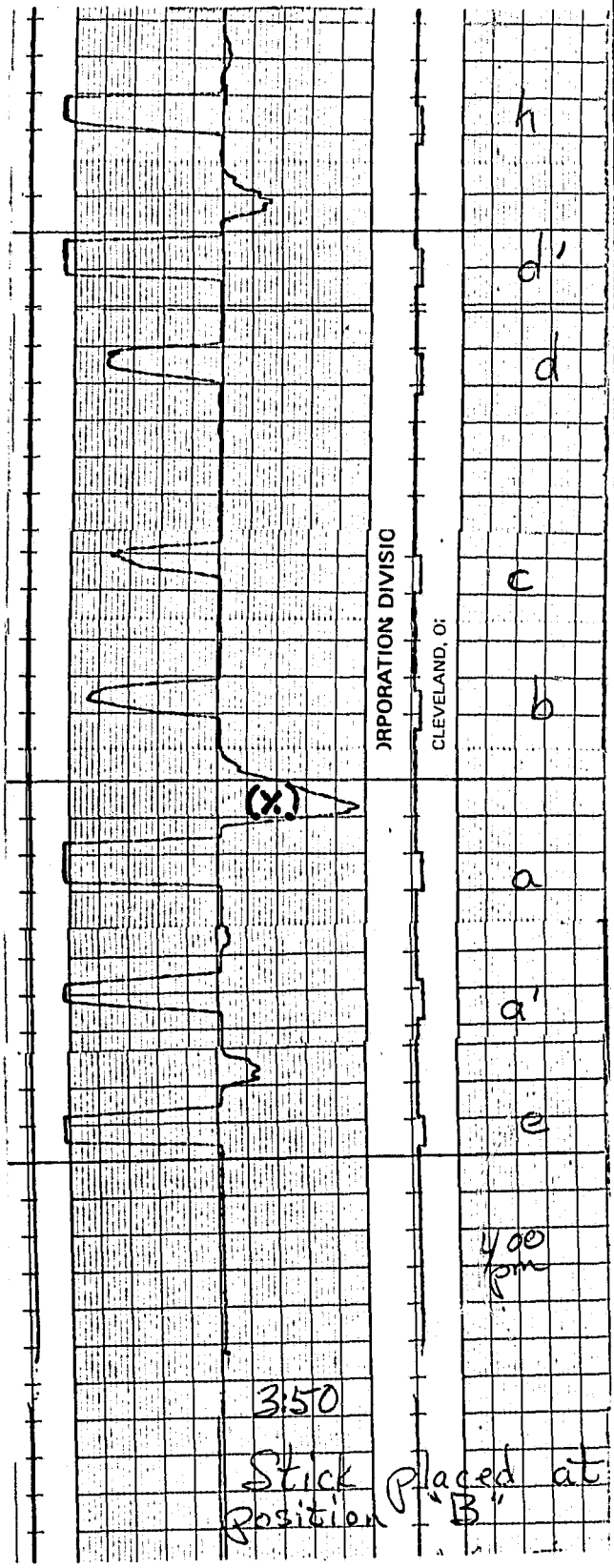
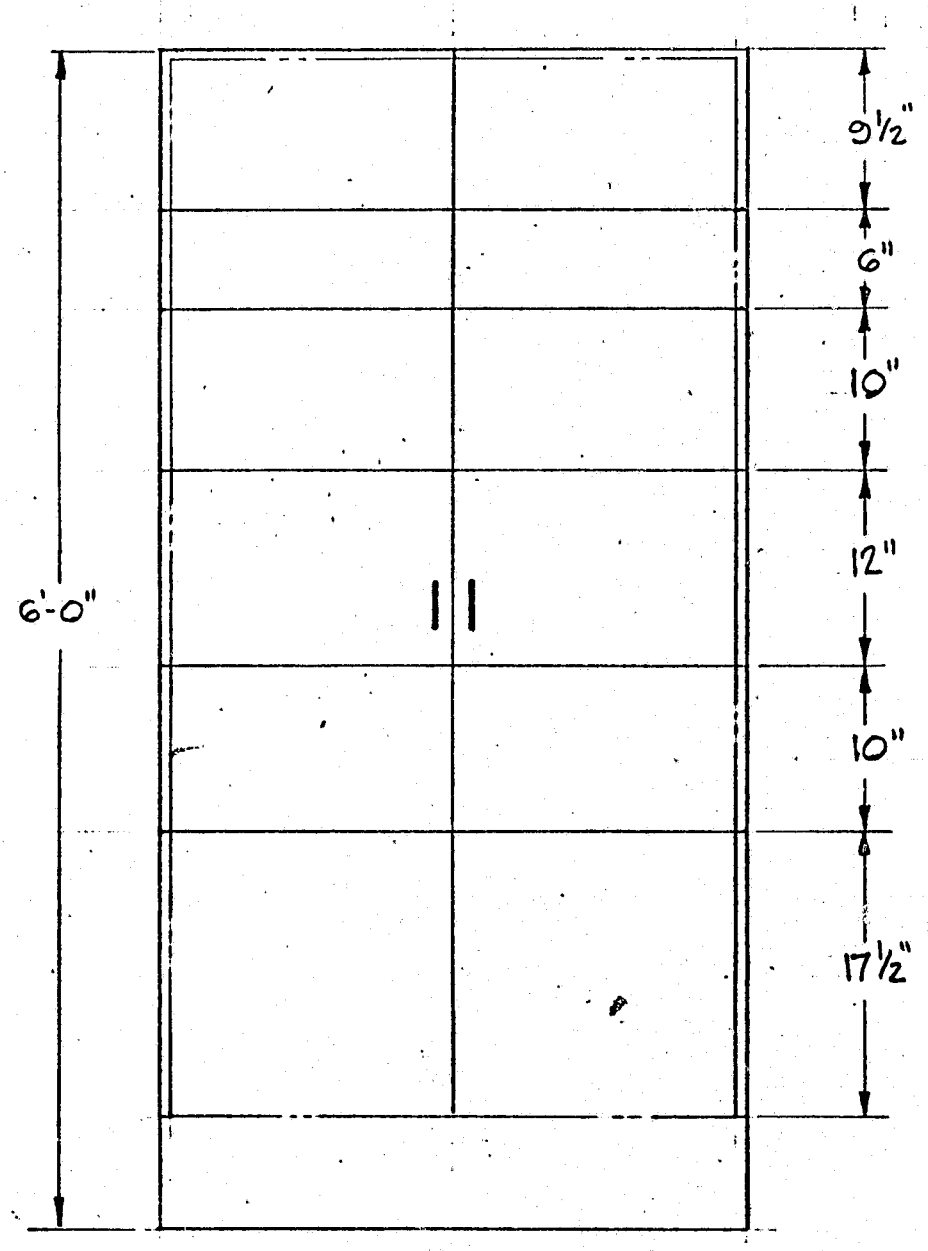


FIGURE 22.

Wall Cabinet Used for Dynamite Detections



Notes:
1. Shelves were number 1 to 6 (top to bottom).
2. Location sites were at center of each shelf.
3. Sampling points were between the cabinet body and doors at end of each shelf.
4. Dimensions of cabinet were 17 3/4 x 36 x 72 inches.
5. Approximate volume, 24 cubic feet.

Each test point was tested at various time intervals after the dynamite had been secreted at the location sites.

Detection of the dynamite vapors was accomplished in less than five seconds sampling time. The dynamite had to be in the cabinet approximately ten minutes before it could be detected. Alarm signals were obtained from all sampling sites, within one hour of dynamite residence time in the cabinet. Figures 23, 24 and 25 represent typical results obtained from some of these tests.

Marijuana Tests

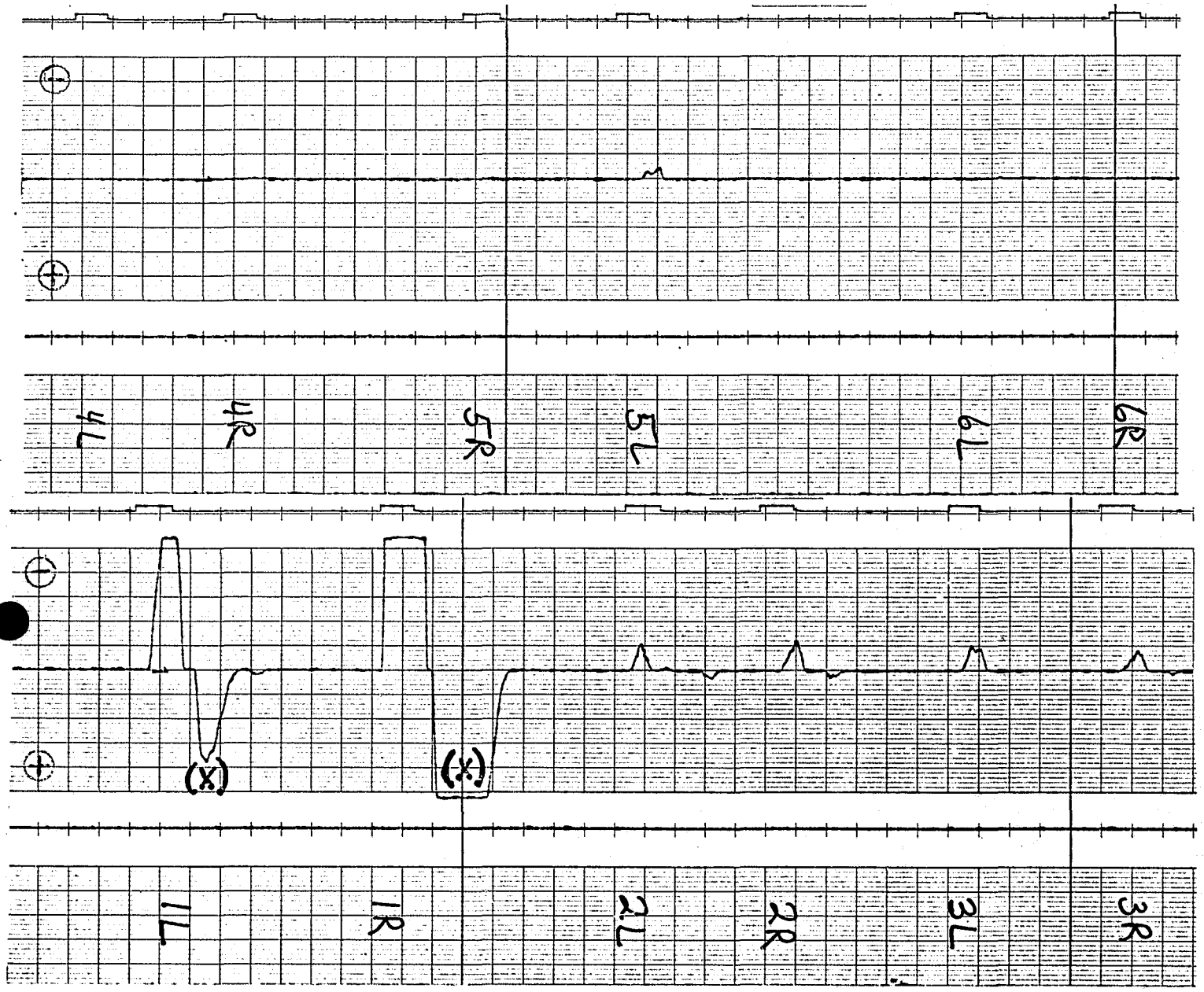
The marijuana biosensors acquired during the latter part of this contractual effort were also subjected to sensitivity evaluations. Although the biological parameters of these sensors had not been fully established, it was of technical value to determine the actual sensitivity possessed by the strains at this stage of development. Of three strains (Figure 26) originally selected for further sensitivity evaluations, only strain C-50-19 was tested because of its consistent responses to the marijuana vapors. The other two biosensors were deleted from further tests, because of sensitivity loss. Another biosensor strain used in these tests was C-117, which reacted to the marijuana vapors with both a positive and negative signal. The polarity of this strain's response signals was controlled by varying the nutrients used for its propagation (Figure 27).

Cylindrical chamber

The sensitivity determinations of the marijuana sensors were started by attempting to detect eighty-seven grams (87 gm) of marijuana located

FIGURE 23.

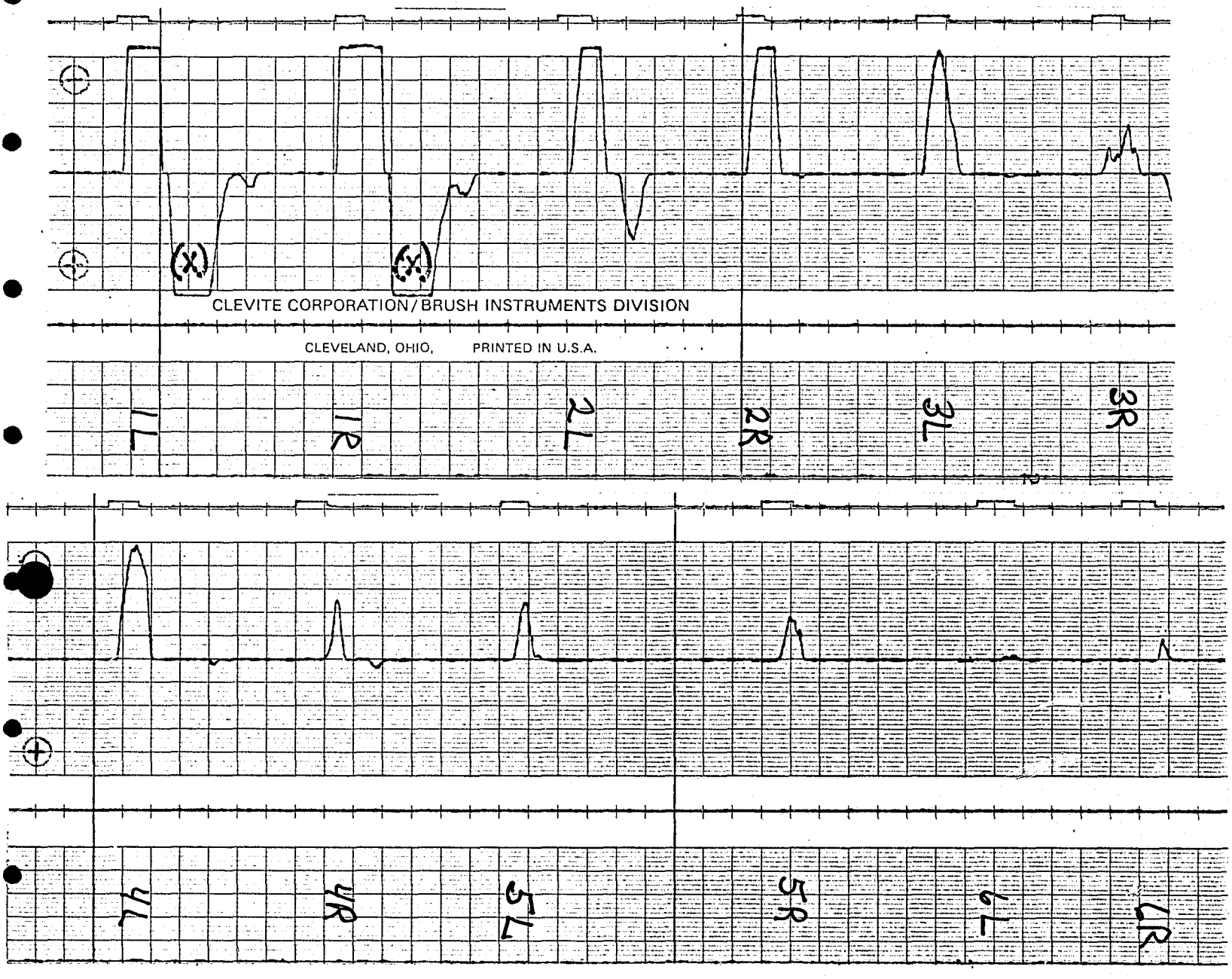
Dynamite Detections from Storage Cabinet



Notes:
1. Refer to Figure 22 for key to sampling points.
2. Tests were conducted with sensor C-70-4.
3. Instrument - NY Prototype.
4. One stick of dynamite placed on shelf 1 (top).
5. Testing began 8 minutes after placement of dynamite.
6. Six shelves were tested at the left (L) and right (R). All exposures were for 5 seconds.
7. Alarm signals obtained from shelves: 1R & 1L, 2R & 2L, 3R & 3L. No Alarm signals obtained on 4th, 5th or 6th shelves.
8. (X) denotes backswing from excessive exposure.

FIGURE 24.

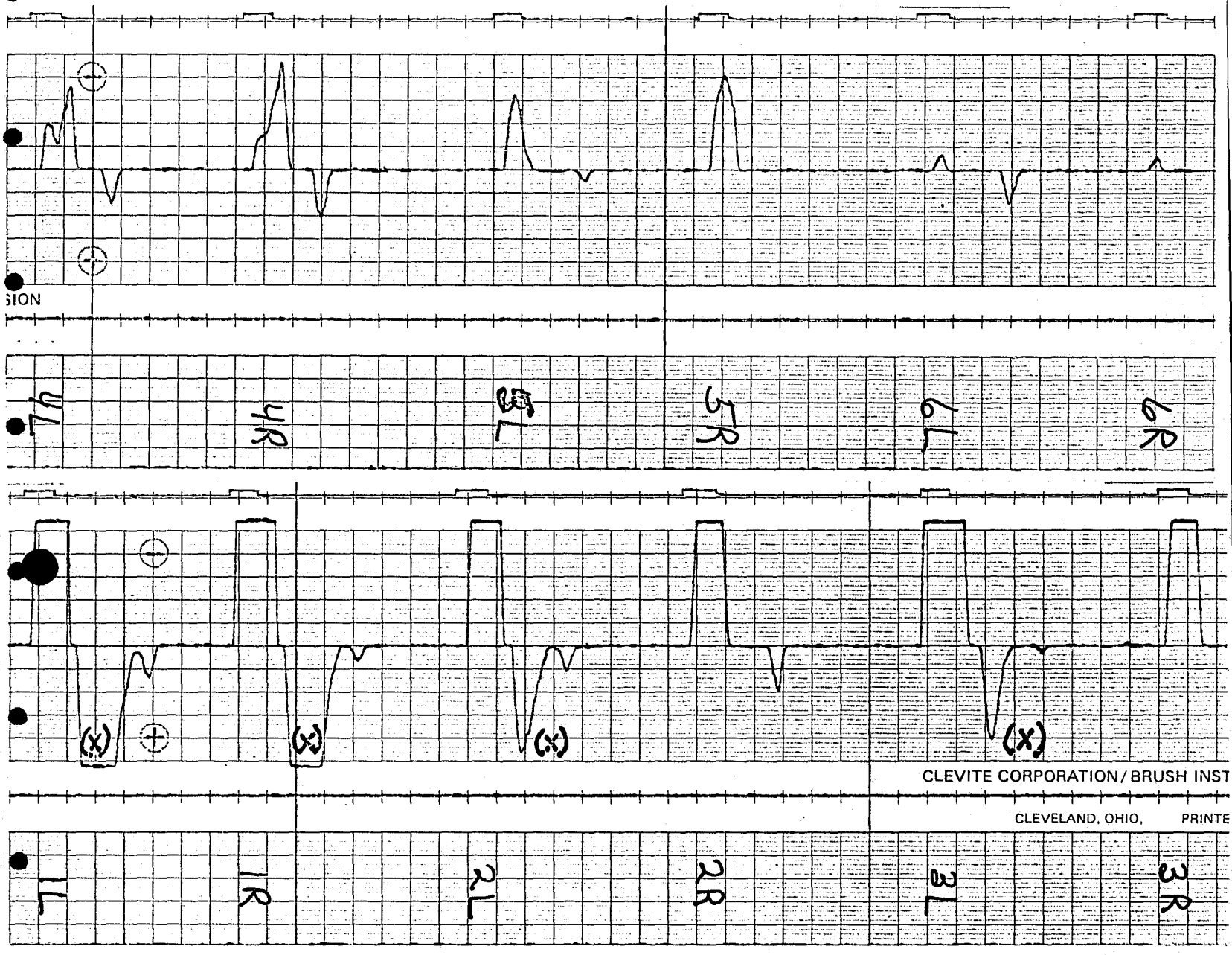
Dynamite Detections from a Storage Cabinet



Notes:
1. Same as Figure 23, except testing began 20 minutes after placement of dynamite.
2. Alarms at all locations, except 6L and 6R.
3. (X) denotes backswing from excessive exposure.

FIGURE 25.

Dynamite Detections from a Storage Cabinet



Notes: 1. Same as Figure 24, except testing began 42 minutes after placement of dynamite.

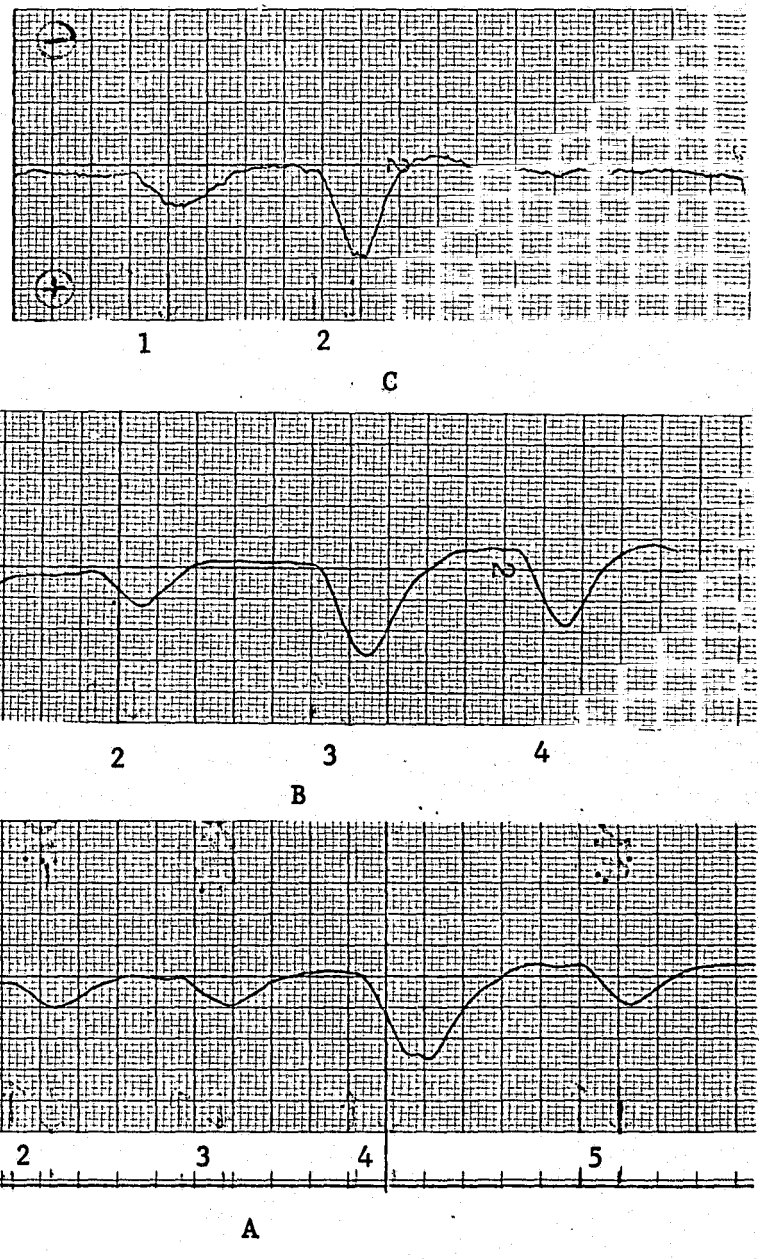
2. Alarms at all test points.

3. (X) denotes backswing from excessive exposure.

FIGURE 26.

Marijuana Detection Signals

(3 Candidate Biosensors)



Notes: 1. Graph A - strain C-50-19
(1) Control
(2) Cocaine
(3) Sucrose
(4) Marijuana
(5) Alfalfa

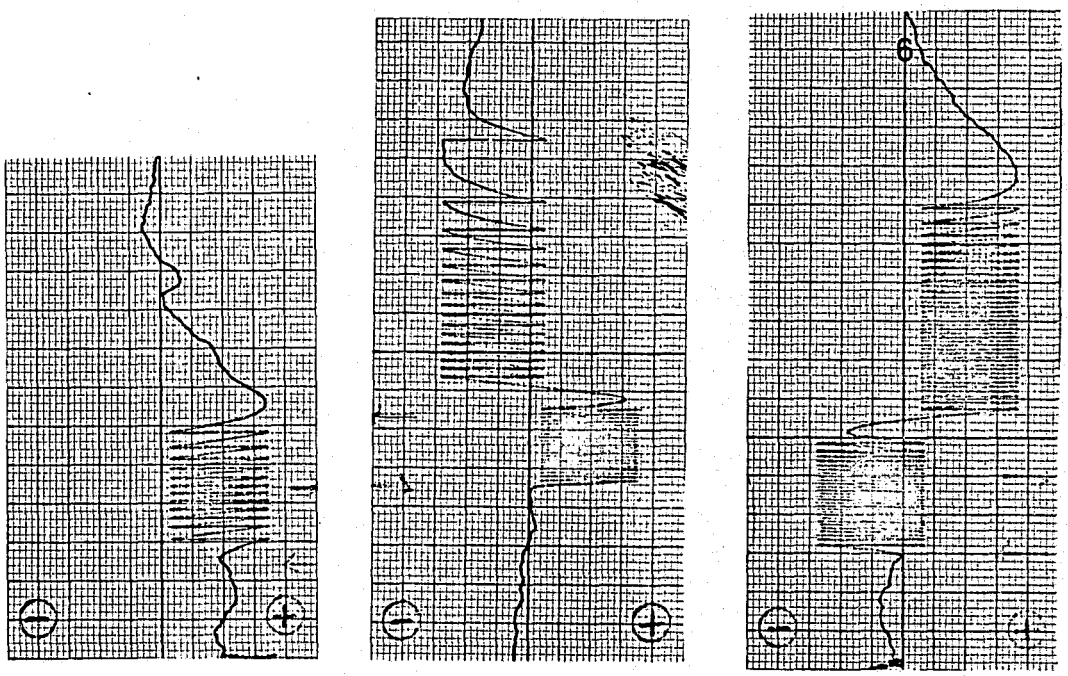
2. Graph B - strain C-51-2
(1) Control
(2) Sucrose
(3) Marijuana
(4) Alfalfa

3. Graph C - strain C-50-38
(1) Control
(2) Marijuana

4. Arrows indicate 5 seconds sampling time.

FIGURE 27.

Positive and Negative Marijuana Signals



A B C

Notes: 1. All response signals represent 10 second exposures to the marijuana vapors.

2. Graph A. Strain C-50-19 on standard luminous nutrient agar (pH 6.5). Positive signal.

3. Graph B. Strain C-117 on #807 nutrient agar (pH 8.0). Positive signal.

4. Graph C. Strain C-117 on soy-peptone nutrient agar (pH 8.0). Negative signal.

5. Electronic mode was rate reset.

inside the cylindrical chamber. A plastic container with the marijuana was placed at the bottom of the chamber. After the marijuana had been in the chamber for thirty minutes, the vapors were detected from the sampling ports fifty-two inches above the marijuana source. See Figure 28 for the detection signals obtained from this experimental test.

Suitcase search

The sensitivity of the biosensors was further evaluated by testing their capability to detect marijuana secreted inside a suitcase. The marijuana package consisted of two marijuana bricks (2 kilograms) wrapped in paper. The biosensor detected the vapors after the marijuana had been in the suitcase for 18 hours. Sampling of the vapors was done by cracking open the lid of the suitcase. Figure 29 shows some of the response signals obtained with one of the marijuana sensors.

Cardboard carton search

The sensitivity of the negative sensor was also tested against the vapors emitted by 87 gm of marijuana located inside a sealed cardboard box. The vapors were sampled through ports spaced at three inch intervals along one side of the box.

Detection signals of the vapors inside the box were obtained only at the sampling port three inches from the marijuana source. The responses never reached a larger amplitude, even after an hour of marijuana residence time. The important fact of this test was that the signals from the marijuana carton were discernible from the control carton (Figure 30). It was hypothesized that the marijuana vapors were absorbed by the cardboard fibers,

FIGURE 28.

Marijuana Signals from Cylindrical Chamber

Notes:
1. Exposure times were 10 second duration.
2. (a) denotes control chamber.
   (b) denotes marijuana chamber.
3. Instrument was LDU-1 with gun probe at a flow rate of 3 liter/minute.
4. Chart recorder set at:
   sensitivity-500mv/div.
   speed -1 mm/sec
5. Refer to Figure 5.

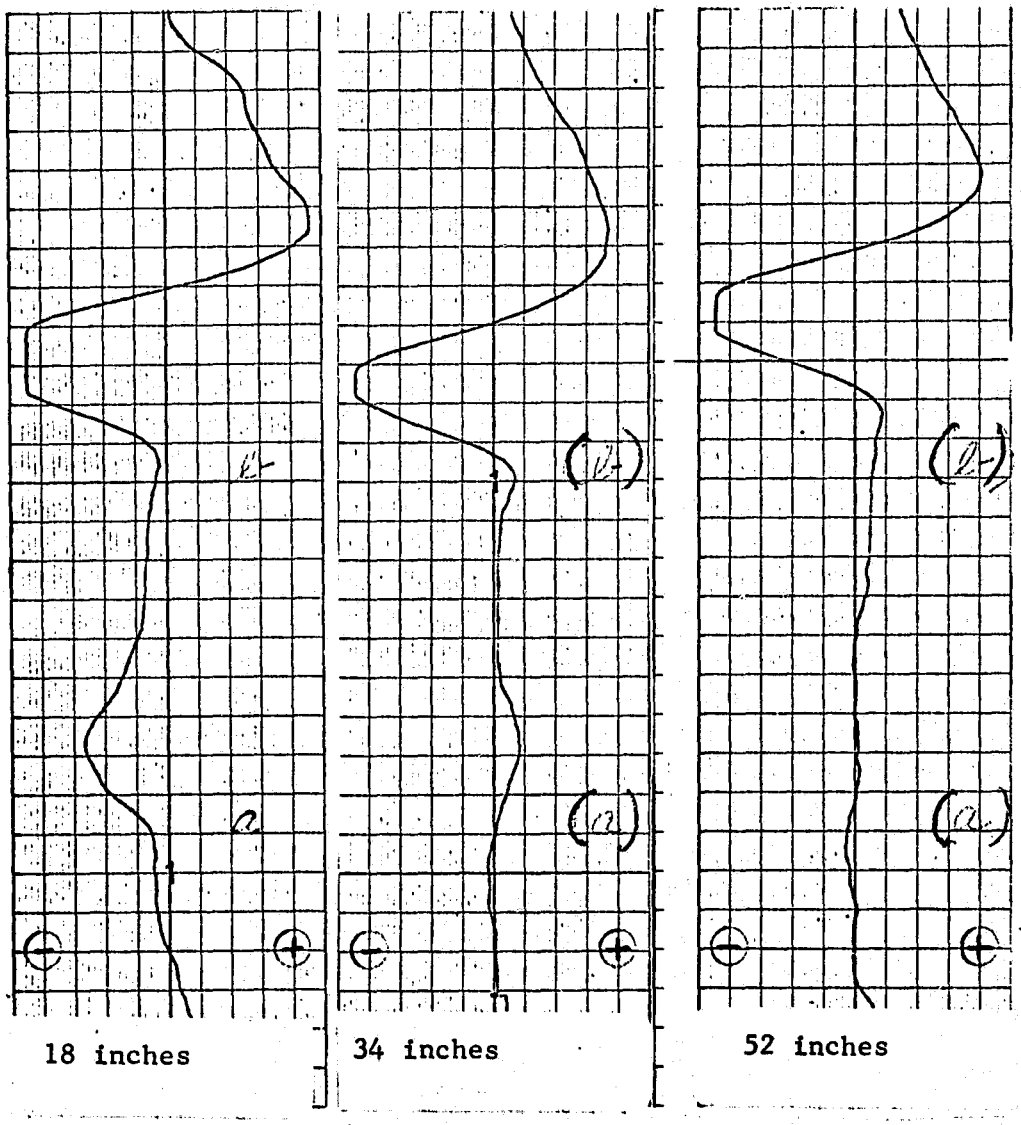


FIGURE 29.

Marijuana Signals from Suitcase

Notes:

1. Exposure times were of 5 second duration.
2. Flask with marijuana was used for control response.
3. Instrument was LDU-1 with gun probe with flow rate of 3 liter/minute.
4. Chart recorder was set at:
   sensitivity- 500 mv/div.
   speed - 1 mm/second

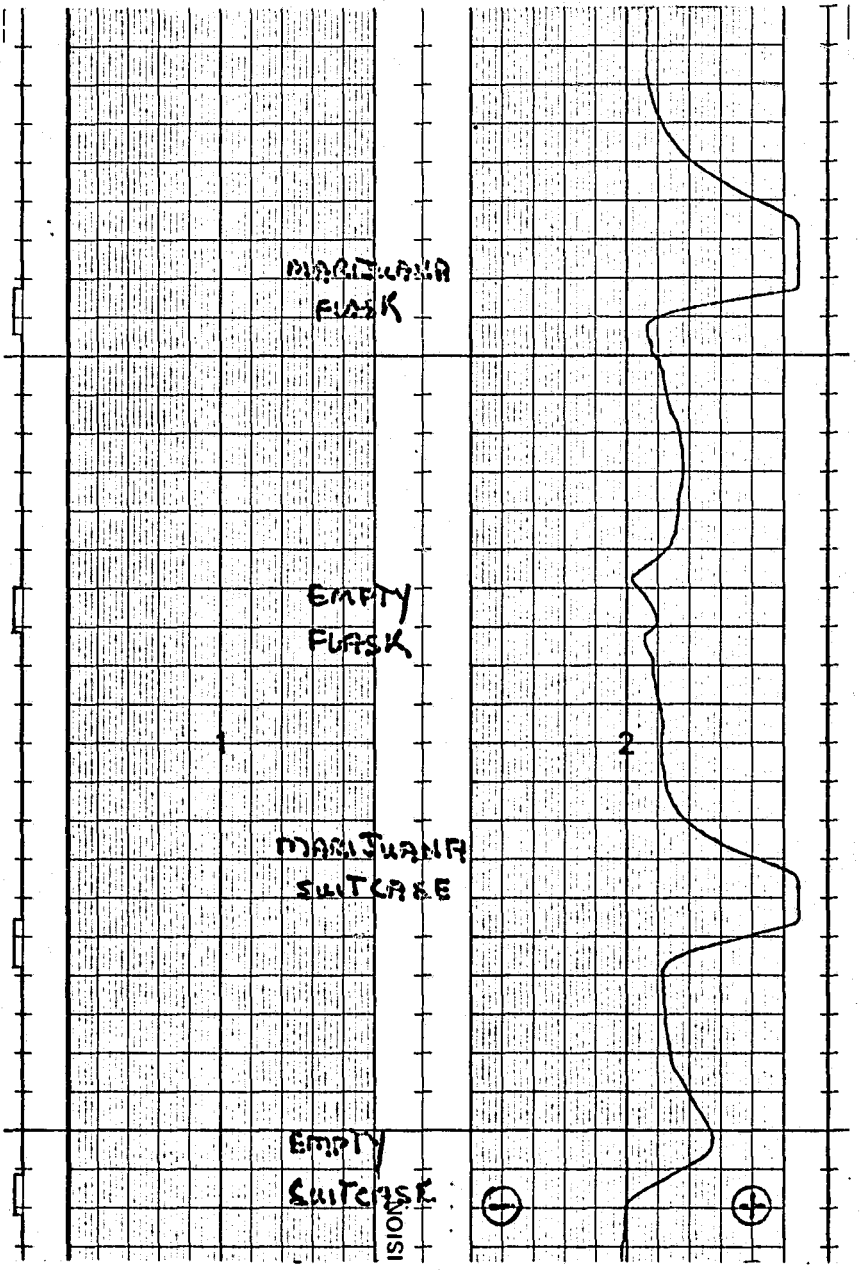
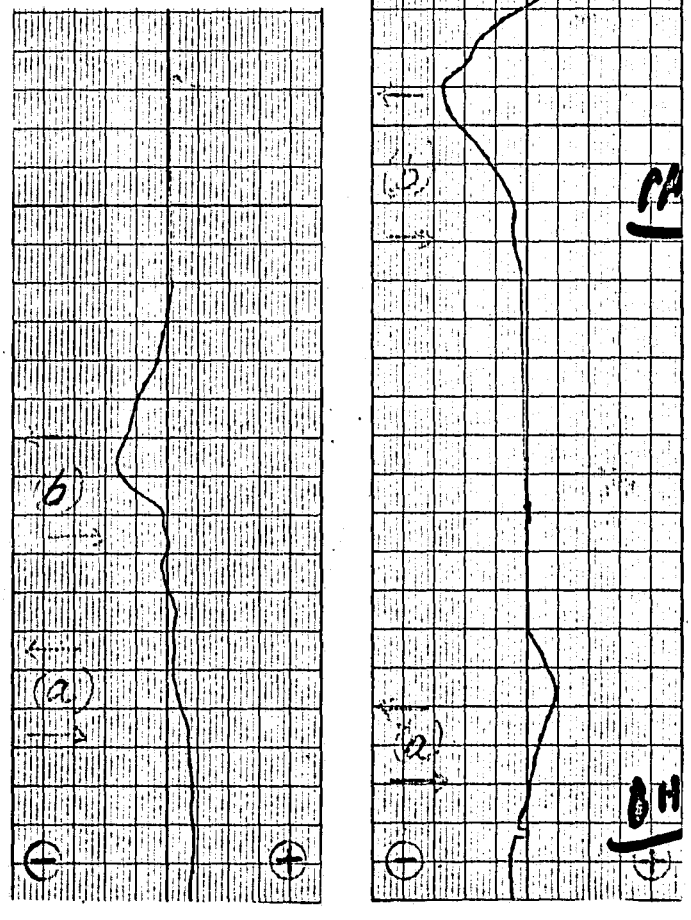


FIGURE 30.

Negative Marijuana Signals from Cardboard Carton

Notes:
1. Graph A represents signals obtained immediately after carton was sealed. Sampling was done at a point 3 inches from marijuana source.
2. Graph B represents signals obtained after marijuana vapors had build-up for one hour.
3. (a) denotes control carton
   (b) denotes carton with marijuana.
4. Arrows indicate beginning (→) and ending (←) of sampling time.



A B

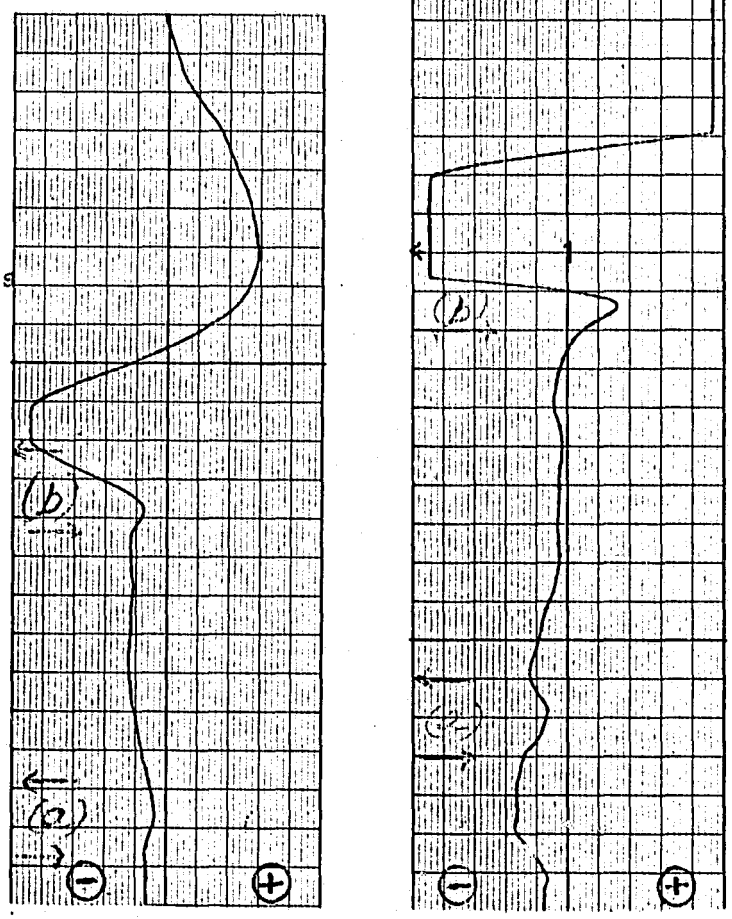
which minimized the amount available for detection. Based on this assumption, the marijuana source was removed from the carton and placed inside a 20-quart plastic bag. Immediately, using the same sensor as for the carton, the vapors were sampled from an opening thirty inches above the marijuana source. This produced the detection signals shown in Figure 31. This may be indicative, that there was an absorption of vapors by the cardboard material. This may be corrected by increasing the dwelling time of the marijuana in the container.

FIGURE 31.

Negative Marijuana Signals from Plastic Bag

Notes:

1. Graph A represents sensitivity responses after 2 minutes of vapor build-up. Sampling point was 30 inches from the marijuana source.
2. Graph B represents sensitivity responses after 10 minutes of vapor build-up. Sampling point was 30 inches from marijuana source.
3. (a) denotes control bag.
   (b) denotes marijuana bag.



A B

DETECTOR FIELD EVALUATIONS (NEW YORK CITY POLICE-LWL)

Field evaluations were conducted by the New York City Police Department with technical direction from the U.S. Army, Land Warfare Laboratory, Aberdeen Proving Ground, Aberdeen, Maryland. The major objective of these evaluations was to verify the applicability of the bioluminescent concept for heroin and dynamite detection in NYPD field situations. Heroin cutting room simulations, heroin in walls and heroin from field seizures were tested by police personnel during December 1971 and January 1972. Dynamite in cardboard boxes, safe deposit boxes and suitcases were similarly tested during the same time period.

RPC personnel acted as technical consultants for instrument and sensor maintenance. The two detectors used were the breadboard detector and the prototype field detector. Sensors were prepared from standard kits by police officers in the field.

Police personnel set up a simulated heroin cutting factory at Ft. Totten in North Queens. Found property heroin was used and realistic cutting was performed with several cutting materials in a selected room of Building 318. Cutting and testing were performed by police personnel exclusively. All data were collected and annotated by the police. (See Appendix A).

Additional tests were performed in the New York City Police Academy Polygraph Room and on individual raids in which alleged heroin powder was seized and tested with the RPC Heroin Vapor Detector. (See Appendix B)

The Contractor view of the performance of the tests by police personnel was one of unqualified enthusiastic admiration. Difficult scheduling and experimentation was overcome in a totally professional manner.

The Contractor view of the results of the tests as documented in the enclosed police records indicate clearly a high degree of sensitivity to heroin with police applications. The unequivocal success during the police evaluation justifies the future application of this concept in controlling the illicit flow of heroin.

A similar view of the explosive testing work is also documented in Appendix B, where the application of bioluminescence for dynamite detection was clearly demonstrated.

BIOSENSOR PACKAGE DEVELOPMENT

The objective of this task was to develop a biosensor package, which would require a minimum of handling for activation of a sensor for field use. It was also important that the package design would provide adequate protection to the biosensors, without hindering its sensitivity or longevity. The biosensor package consists of three major components and will be described separately.

Lyophilized Biosensors

The biosensors had to be prepared and packaged in a manner which would allow for their maximum storage and yet remain in a convenient state for rapid activation. Based on the technical experience gained from previous studies of this type, it was decided to utilize the technique of lyophilization (freeze-drying). This method of bacterial preservation is presently used at RPC Corporation for preservation and storage of stock cultures. It has proven to be a reliable means of storing cultures indefinitely and prevents the loss of their specific physiological properties i.e., reactions to the vapors of interest. The procedure for freeze-drying the biosensors was as follows: Cultures of each biosensor grown on luminous agar plates were harvested in 5 ml of beef serum (Difco) or 10% skim milk (BBL). The suspensions were transferred to sterile 25 milliliter flasks which contained a small magnetic stirring bar. The flask was placed on a Magnestir and the contents stirred to obtain a homogeneous suspension. Aliquots (0.05 ml) of the suspension were then transferred with a sterile hypodermic

syringe to freeze-drying tubes. Cotton plugs were inserted approximately 1 1/8 inches below the top of the tubes. The tubes were then attached to the freeze-drier manifold and lowered into a bath maintained at -50°C. The bath consisted of solid carbon dioxide and cellosolve (Ethylene glycol monoethyl ether). When a vacuum of 5 to 15 microns was attained (1½ hours), the tubes were removed from the bath and allowed to dry at room temperature for 1½ hours. While still under vacuum, the lyophil tubes were sealed with a Hoke oxygen - natural gas hand torch. The sealed tubes were later tested for leaks with a high voltage generator. These tubes were prescored to facilitate breaking them open to gain access to the pellet when needed.

Activation Mode Container

Since freeze-drying places the biosensors in a quiescent state, it is necessary to reactivate their metabolic functions when their use is desired. This activation can be accomplished by suspending the freeze-dried pellet in nutrient broth or crushing the pellet into powder and sprinkling it on solid nutrient agar. Laboratory trials with these two methods revealed that, at this time, it was more practical to use the pellet-to-liquid mode for field applications. Various container configurations were evaluated to find a practical one to use for the activation fluid. The configuration evaluations showed that the best container for the desired application was a flexible plastic bottle (15 ml). The preparation of the bottles for activation of the biosensors was conducted aseptically with sterile materials as follows: ten milliliters of nutrient liquid were introduced into each bottle. Then a lyophilized pellet, still in

the sterile, sealed lyophil tube, was placed inside the liquid nutrient bottle.

When it became necessary to activate the biosensor pellet, the lyophil tube was broken along the prescored mark by flexing the plastic bottle. This caused the pellet to come in contact with the nutrient fluid, which suspended the pellet and initiated growth.

Biosensor Cartridge

This component of the biosensor package serves a twofold purpose: (1) It serves as a matrix, which contains the nutrients necessary for the biosensor's metabolic activities including sensitivity; (2) Once the cartridge is inoculated with the bacterial strain and inserted into the detector apparatus, it becomes the sensing device of the detector unit. The cartridge surface area was reduced in size from a petri plate (35 millimeters) to a small plastic two milliliter beaker (13 millimeters). This reduction in size simplified package development and aided in the design of a portable field detector unit.

Two problem areas were encountered in the development of the cartridge, which were rectified through some laboratory studies.

The first problem concerned the dehydration of the agar-base matrix contained in the beaker cartridge. If the relative humidity was low, in the incubation area, moisture would escape from the matrix and affect the viability of the biosensor. This problem was corrected by incubating the cartridges in a field plastic incubator, which contained water soaked

materials (absorbent paper) and prevented dehydration.

The other problem encountered with the cartridge was contamination with undesirable microbial growth (yeast, fungi). This particular problem was eliminated by the addition of an antibiotic to the nutrient matrix. Acti-dione (Upjohn-cycloheximide) was the antibiotic selected for incorporation into the media. This antibiotic is toxic for the contaminants, but does not interfere with the growth of most bacteria. Nutrient agar plates were made, which contained Acti-dione in strengths of 0.1 gram/liter and 0.5 gram/liter (gm/l). The control plates did not contain Acti-dione in the media. The test plates were inoculated with dynamite and heroin sensors and incubated at 70°F for 24 hours. The biosensors were then exposed to heroin and dynamite vapors. The growth, luminescence and sensitivity of the biosensors was not affected by the addition of Acti-dione to the nutrient agar.

Some of the Acti-dione plates were inoculated with suspensions of fungus spores (Penicillium sp.) and incubated at 70°F to verify the fungistatic efficiency of the antibiotic. The plates were observed for growth every day for six days. The untreated plates had heavy fungal growth after three days of incubation. The 0.1% acti-dione plates had light fungal growth after four days and the 0.5 acti-dione treated plates had light fungal growth after 20 days. These results were indicative of mild fungistatic activity of the antibiotic, Acti-dione, at the concentrations described above. Since the results achieved by the addition of Acti-dione to the nutrient agar proved successful, it became a standard

ingredient in all nutrient formulations.

The prevention of contamination was also aided by packaging the biosensor cartridges aseptically. The aseptic procedure consisted of sterilizing the plastic cartridges, caps and squeeze bottles in a Cryotherm (American Sterilizer Company) for a minimum of four hours. The Cryotherm utilizes a gas mixture of ethylene oxide (12%) and Freon 12 (88%), which is heated to a temperature of 50 degrees centigrade (C°). After the cartridges are sterilized, the steam autoclaved (121°C) nutrient agar is poured into the beakers and capped. All handling procedures are done in a "clean" environment with the operators wearing pre-sterilized rubber gloves and observing all aseptic microbiological techniques commonly approved in microbiological laboratories. This involves disinfection of all table and wall surfaces with an appropriate disinfectant such as Wescodyne.

The complete biosensor package has been used in the field by the New York Police and other personnel. It is very easy to use, even by untrained personnel. Figure 32 is the set of instructions on how to use the biosensor package kit.

FIGURE 32.

Instruction Sheet

Sensor Preparation

Kit contains 1 squeeze bottle with inactivated sensor, activation fluid and cartridges.

1. Loosen screw cap and squeeze air out of bottle.
2. Tighten cap and flex bottle to break contained ampoule.
3. Loosen cap, let in air and swirl to mix.
4. Let stand 2 days at room temperature with cap loosened to permit growth of sensors.
5. Remove cap from cartridge and add ½ drop of liquid from squeeze bottle to surface of gel.
6. Leave cap off cartridge and incubate 24 hours at 65 to 70°F (20 ± 1°C) in a clean moist atmosphere prior to use.
7. Prepare replicates.

NOTE: Refrigerate uninoculated supplies

OPERATIONAL EQUIPMENT

Engineering activity under this program entailed hardware refinement, fabrication and delivery of detector systems utilizing concepts established under a previous feasibility study for the New York City Police Department. Two sets of hardware were provided, i.e., "breadboard" and "prototype", each set consisting of four detector systems. Objective of the "breadboard" set was to gain field experience and evaluation in order to incorporate recommended improvements into the "prototype" systems, subsequently delivered.

Breadboard Systems

Configuration of the breadboard system stemmed primarily from data derived from a laboratory prototype detector built for that purpose (FDU-1). This unit served not only as a test bed for a biosensor environmental control system but also provided information on: sources of signal noise, performance of inlet nozzle designs, and effects of flow impingement on biosensors. The laboratory prototype unit, therefore, served a useful purpose by revealing technical weaknesses, which were subsequently investigated in detail and corrected. Additionally, battery power requirements were determined for a minimum operation time of the detector of two hours for a hot summer day, New York City environment.

The foregoing background of engineering engendered the following "breadboard" system subassemblies:

Detector
AC Power Supply
Battery Pack
Battery Charge Controller

Versatility has been built into the detector system (Fig. 3) for remote operation, in that it may be clamped to the battery pack and carried as an integral unit, or detached from the battery pack and reconnected to a ten-foot cable for use in abnormal physical positions. The AC power supply is physically and electrically interchangable with the battery pack. Weight of the detector/power supply combination is approximately twenty-five pounds.

Detector

Except for power supply, all circuits, components and displays necessary for system operation are contained within the detector.

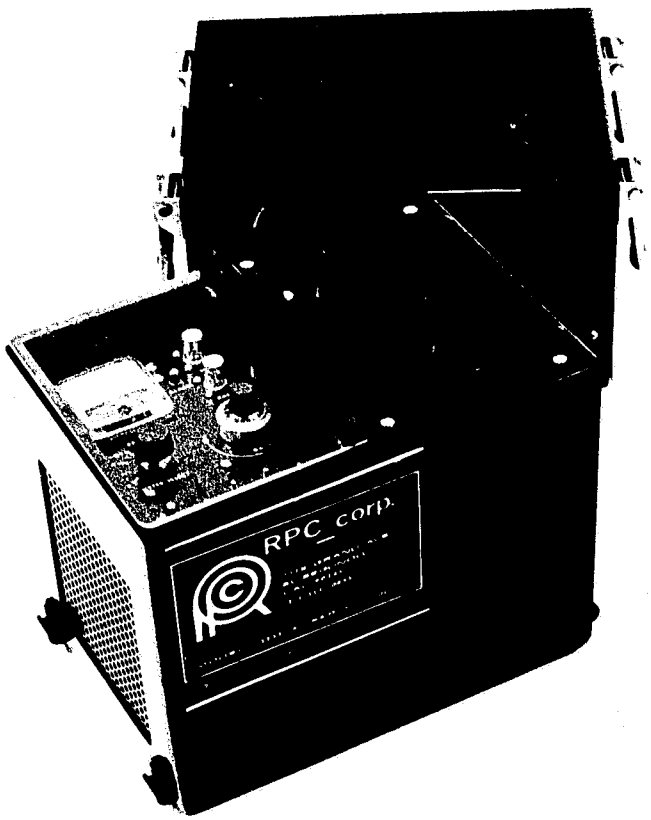
The biosensor chamber is fabricated of stainless steel to house a miniature biosensor cartridge. Biosensor cartridge replacement is made through an access door in the end of the detector. A diaphragm-type air sample pump was selected for use because of its availability, good reliability and flow adjustment capability.

Temperature control of the biosensor chamber is provided by electronically regulating the power to a Peltier thermo-electric element attached to the chamber. Heating or cooling control mode is selected by a switch on the detector's panel. A finned heat exchanger and associated blower functions to remove unwanted heat(for cooling) from the Peltier unit. The Peltier concept of conversion of electric power to heating or cooling was chosen for its small size, high reliability, and capability to supply heating or cooling simply by reversing the current flow from an electric source.

Controls are arranged for convenient use on a small panel on the top of the detector. A hinged plastic window protects the controls from adverse

FIGURE 33.

NYPD Breadboard Detector System



weather conditions, and from inadvertent physical contact.

AC power supply

The power supply, built for standard 115 volt 60 Hertz power, provides regulated DC voltages for detector electronics and air sample pump. Unregulated DC power is supplied to the Peltier thermoelectric units. The supply is additionally used to supply battery charging power through the charge controller. The supply is equipped with an off-on switch, fuse and indicator light.

Battery pack

This module is physically and electrically interchangeable with the AC supply for use with the detector. Lead-acid batteries were chosen for their ruggedness, many charge/re-charge cycles capability, and convenient availability. Because the detector draws no current when turned off, the battery pack is not equipped with an on-off switch. Internal fuses, however, protect the batteries from accidental short circuit.

Battery charge controller

Although lead-acid batteries are rugged and reliable, the number of their charge/re-charge cycles can be extended by proper charge control. For that reason circuits were fabricated to provide the proper charge rate and cutoff automatically, as recommended by the manufacturer. An operator has only to press each of the two button switches on the controller panel to begin the battery charge sequence. Having observed that each of the associated pilot lights remains on, he then has only to wait until both lights automatically extinguish to know that the batteries are fully charged. This can be from less than an hour to fifteen hours, depending on the state of battery discharge.

Field evaluation

Two of the breadboard systems were delivered in May, 1971 to the New York City Police Department for use in field evaluation. The remaining two were held by RPC for laboratory evaluation and for incorporation of such modifications as might be requested by New York. One significant finding by the New York Police field personnel was that the "breadboard" system was too heavy to satisfy an objective of true portability. That finding, together with improvements found desirable from laboratory evaluations at RPC, formed the basis for design of the "prototype" units, Task IV of the program. The following is a summary of those development objectives undertaken for incorporation into "prototype" system design:

Reduce weight
Reduce size
Increase use-time before battery re-charge
Incorporate a fully-automatic temperature control
Simplify detector operation
Incorporate a means for effective humidification

Prototype Systems - Weight Reduction

The largest potential item for weight reduction proved to be the battery pack, which weighs over fifteen pounds. A two-prong attack was launched; first, to modify circuits and hardware to use less battery power and second, to obtain batteries with the highest power-to-weight ratio. Reduction of power used by the detector was achieved by reducing the metallic mass of the biosensor chamber, employment of more effective thermal insulation, and replacing blower-cooling with passive-cooling of the Peltier thermoelectric unit. As a result, power consumption dropped to a third of the previous

amount. A survey of the latest state-of-the-art in batteries was then made. Selected for use was a silver-zinc type developed for the aerospace industry, and which is only one-fourth as heavy as the lead-acid types used for the "breadboard" system. System weight was thereby reduced from twenty-five pounds to eight pounds - a considerable saving.

Size reduction

Coincident with the activity for weight reduction came a corresponding reduction of size. Additionally, a program was launched to simplify circuitry, and thereby reduce its required volume. This program also proved effective in its objective, and in addition, allowed the incorporation of the feature of automatic battery monitors. The size reduction program produced a reduction of the combined detector and battery pack from 845 cubic inches to 306 cubic inches.

Increased battery use time before re-charge

Although the battery pack of the "breadboard" system met its original objective of two hours operation, program objective for the "prototype" was for operation of four hours in extreme New York environments. Because of the high degree of success achieved in the battery size and weight reduction program, described above, it was possible to extend their operational time to approximately eight hours - thus doubling the objective time of four hours.

Fully automatic temperature control

The temperature control employed by the "breadboard" system is automatic, but it requires operator determination of ambient temperature in order to select a mode switch position of heating or cooling. To simplify operation by removing that operator decision, circuit design of the temperature control

was modified so that automatic control is effected, regardless of what the ambient temperature may be - thus providing fully automatic control. Figure 34 is a chart recording of control performance while operating in an environment of 95°F and 95% R.H. This shows the chamber is held to 69°F ± 0.1°F - well within that required.

Simplification of detector operation

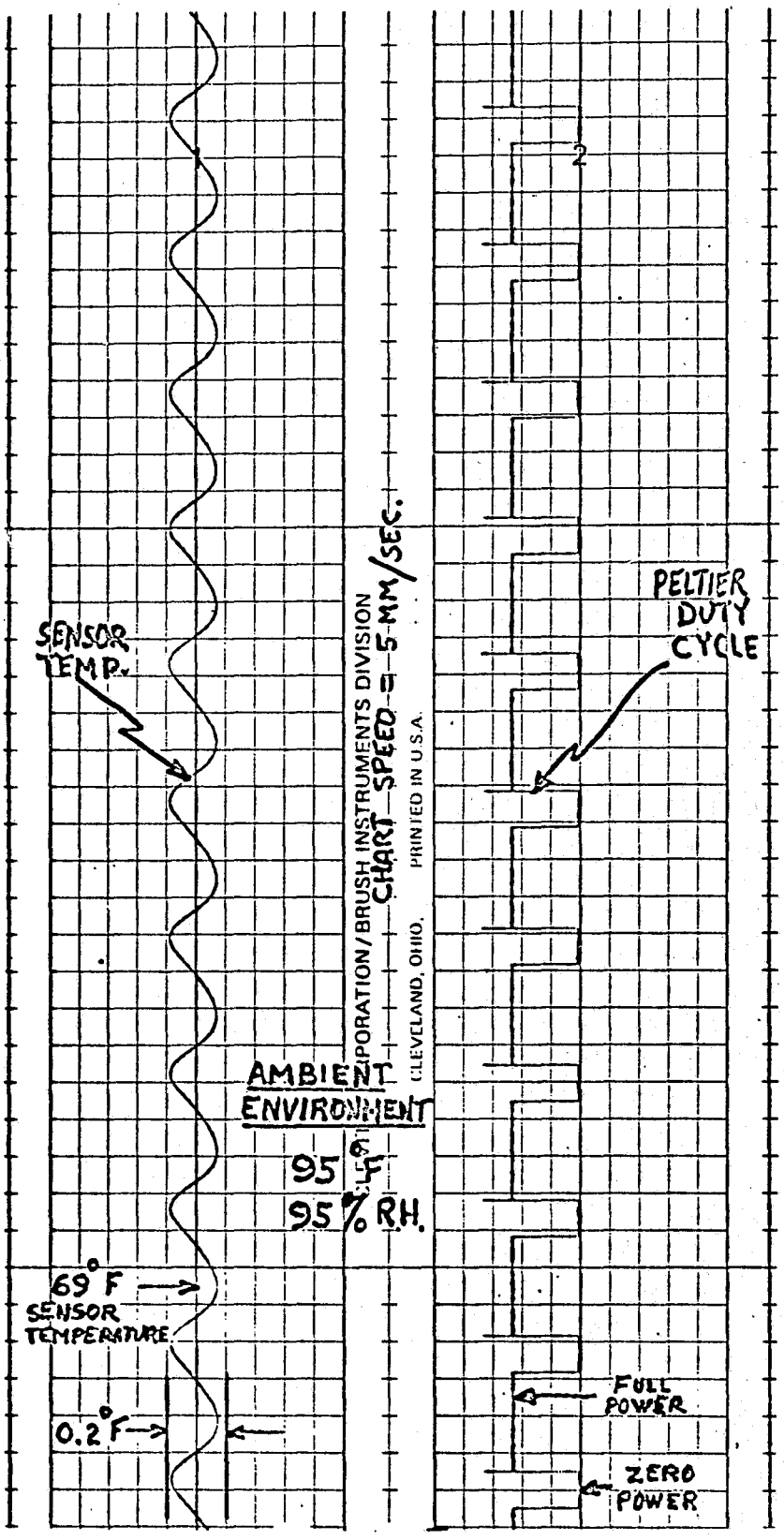
Although a great amount of field evaluation data was not available for use in assisting the simplication program, considerable human engineering analysis was made based upon RPC's best estimates of what true field operation would consist of. Features of the prototype, therefore, were engendered by that precept. As a result, it is felt that a new operator of the prototype detector will require not only less training but will also find he has fewer controls to manipulate than was necessary for the "breadboard". For example: the six functional switches of the "breadboard" detector have been reduced to two in the prototype - a simple power on-off, and an audio alarm on-off switch. The function of, and potentiometer for intensity level set have been eliminated. The meter and associated selector switch have been replaced by lights for null indication. For diagnostic use in the laboratory, a plug-in meter has been provided for quantitative measurements. RPC laboratory experience with the "prototype" configuration has born out the success of the operating simplification program.

Humidification

Of the several technical challenges posed in development of the "prototype" system, perhaps humidification was most difficult to solve. Prior studies of the subject have been made by RPC under another program

FIGURE 34.

Performance of Fully Automatic Temperature Control



in which several methods and techniques of humidification were discussed. Simply stated, serious problems stem from the interdependence of the humidity/temperature relationship, in addition to a tendency for vapor absorbtion by liquid water particles.

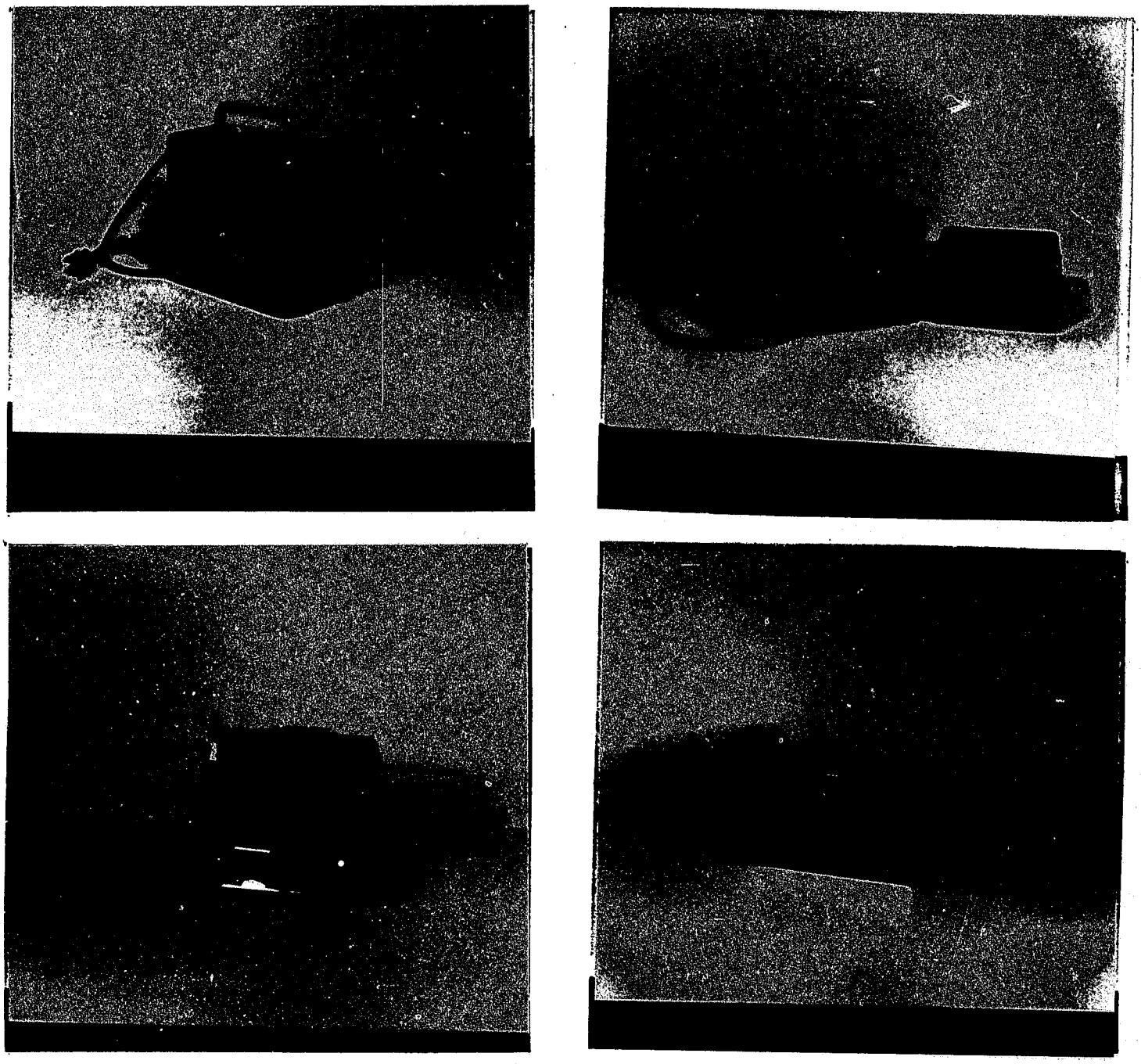
A good degree of success has been demonstrated by passing the (dry) vapor sample through a smooth-walled, but porous ceramic tube, whose outer surface is moistened by cotton saturated with distilled water. This configuration is employed by the "prototype" detector. Although 100% humidification is not normally obtained, sufficient moisture is generated to preclude all but the heaviest humidity-type interferences from appearing as a signal. Better humidification can be shown to result from increasing the temperature of the humidifier by a prescribed amount, depending on ambient humidity and temperature conditions. The gain in performance, however, was not considered enough to justify the increased complexity and power consumption of the circuits and components necessary for precise control.

Photographs in Figure 35 show the final configuration of the prototype system in its portable (DC) mode. The detector with the heat exchanger fins measures approximately 6½ x 7 x 5 inches and weighs 4½ lbs. It is connected by means of a 3 ft. power cord to a battery pack which can be clipped on a belt. This battery pack weighs 3½ lbs. with dimensions of 2½ x 5 x 5 inches.

Manuals and schematics of the devices are included as Appendices C and D.

FIGURE 35.

NYPD Prototype Detector Unit

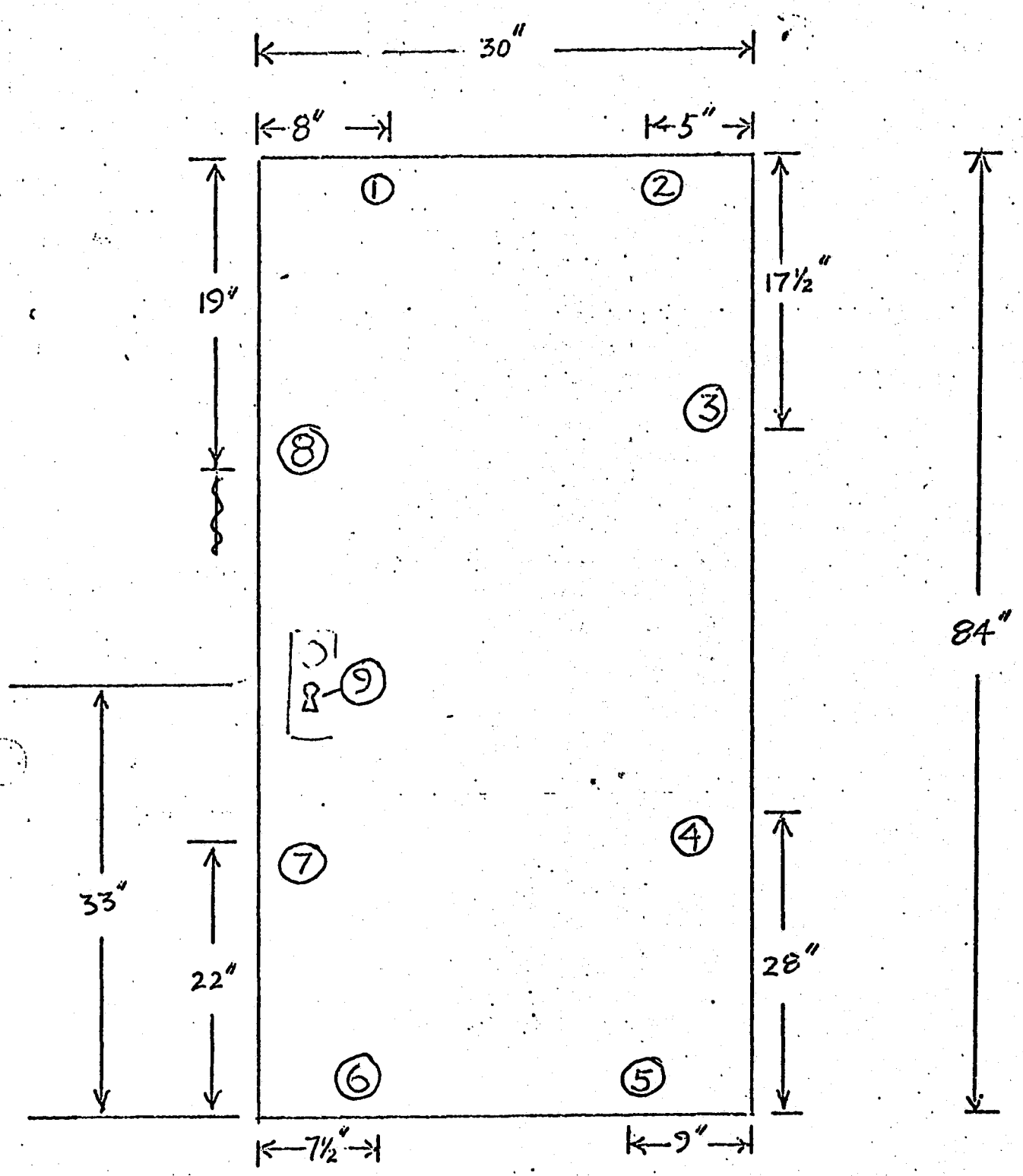


APPENDICES

APPENDIX A

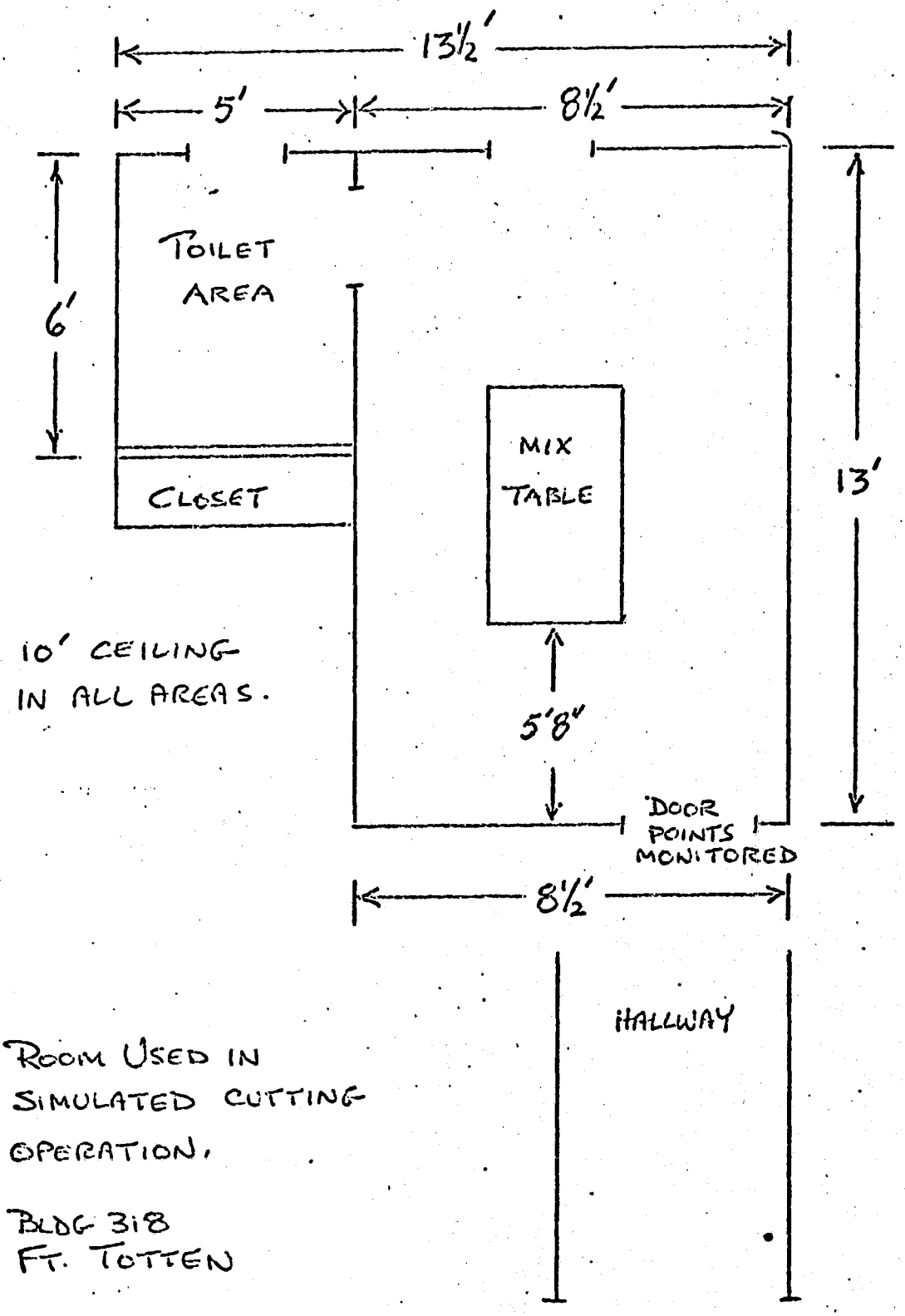
Simulated Cutting Rooms

(New York City Police Department Records)



DOOR POINTS MONITORED IN TESTING SIMULATED HEROIN FACTORY

NOT TO SCALE



ROOM USED IN SIMULATED CUTTING OPERATION.

BLDG 318
FT. TOTTEN

Time	
1100	The pump in the detector appeared to be "laboring" and was cleaned.
1115	Unit now appears to be operating properly.
1123	Unit stabilized.
1125	Personnel monitored. Unit registered numerous positive alarms during this procedure. It was determined that the alarm was triggered when held close to the face and was apparently caused by breathing on or near the probe of the unit. Personnel were monitored again - no response.
1145	Personnel monitored as a group - no response.
1200	Testing was terminated due to insufficient supplies and members returned to the NDSIU office to make arrangements to obtain the requised mixing materials.

- - -

Time	
0825	Detector was activated and immediately gave indications that the pump was not operating properly. For the next forty minutes the pump stopped numerous times and it was necessary to tilt or tap the machine to keep the pump operating. (This malfunction may have been due to the fact that the machine was exposed to extreme cold during transport. 17 degree outside temperature).
0930	Detector stabilized.
0945	Detector was tested against known heroin and responded once positive and twice negative.
0955	Sensor was changed due to poor response and took 8 minutes to stabilize.
1010	Sensor was tested against heroin and responded once negative and twice positive.
1020	Testing room monitored. Strong negative response in the toilet area. Door points monitored. Positve response at point #3. (possibly due to restricted air flow when probe placed between the door and door jamb).
1035	Monitoring of room and door completed. No false alrms other than that recorded at point #3. A second test at point #3 gave no response.
1100	Personnel monitored - no response. Materials monitored - no response. Heroin monitored - positive response within 3 seconds.
1145	Sensor replaced due to prolonged negative reaction after unit had been placed on "standby" while the cutting materials were being placed in the test room. (During this time work was being conducted on the oil burner in the building and there was a strong odor of oil throughout the building).
1155	Detector was placed in the hallway outside the test room to stabilize in that location. Moving the unit from one room or area to another caused it to move to a negative reaction.
1205	Mix operation started in the test room.
1230	Alarm sounded while unit was 11 feet from the test room. Unit permitted to stabilize at that point.
1310	Door monitored while team was conducting mix operation in the room. Temperature 74 deg. Humidity 16 pct.

Door Point -	1	2	3	4	5	6	7	8	9	
Reaction	P	P	P	P	P	P	P	P	P	P - positive
Time (sec.)	4	3	3	4	10	10	5	5	5	

1345 (Same as at 1310)

Door Point	1	2	3	4	5	6	7	8	9	
Reaction	P	P	P	P	P	N	P	P	P	N - no response
Time (Sec)	4	4	5	9	6	10	5	4	3	

1350 Team left the mix room, mix #1 completed.

1400
1405 Test #1 conducted. (See test sheet #1, 1-17-72)

1425 Test #2 do do

1445 Test #3 do do

1510 Team reentered test room to begin mix #2.

1515 Sensor replaced and allowed to stabilize.

1530 Test while members in mixing room. Temp. 70 deg. Hum. 16 pct.

Door Point	1	2	3	4	5	6	7	8	9
Reaction	P	P	P	N	P	P	N	N	N
Time (sec.)	7	4	6	10	9	9	10	10	10

P - positive
N - no response

1530 Mix was completed and team now left the room.

1545 Test #1 conducted. (See test sheet #2, 1-17-72).

1605 Test #2 do do

1625 Test #3 do do

1715 Team reentered room to conduct mix #3.

1730 Test while team in room and mixing. Temp. 78 deg. Hum. 16 pct.

Door Point	1	2	3	4	5	6	7	8	9
Reaction	N	N	N	N	N	N	N	N	N
Time (sec.)	10	10	10	10	10	10	10	10	10

N - no response

1735 Sensor changed due to no response at any point at 1730. Team out.

1750 Test #1 conducted. (see test sheet #3, 1-17-72).

1810 Test #2 do do

1825 Test #3 do do

1850 Testing concluded.

DATE: January --, 1972 OUTSIDE TEMP. 17 deg. HUMIDITY 47%
TYPE: Simulated heroin cutting factory
PLACE: Fort Totten, NY, Bldg. #518

The following tests were conducted at 15 minute intervals after a simulated heroin cutting operation was conducted using the materials indicated below and on the following pages.

MATERIALS: 4 oz. heroin, 4 oz. quinine, 12 oz. mannite.
TEMPERATUR: 74 deg.
HUMIDITY: 16%

Time: 1405 TEST #1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	P	P	P	P	P	P
Time (Seconds)	3	3	5	8	7	4	5	5	4

425 TEST #2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	P	P	P	P	P
Time (Sec.)	5	4	3	10	7	5	6	6	5

1445 TEST #3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	P	N	P	P	P
Time (Sec.)	8	5	10	10	5	10	8	5	7

The above tests were conducted with the windows closed.
The use time of the sensor was three hours.

A 10 second maximum time limit is allowed on ALL tests to be conducted.

TEST SHEET # 2

DATE: January 17, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 3 oz. mannite added to previous mix. (Sheet #1)

Time											
1545	TEST #1										
	Door Point:	1	2	3	4	5	6	7	8	9	
	Reaction:	P	P	P	P	P	P	N	P	P	P - positive N - no response
	Time (Sec.)	2	4	5	5	6	5	10	10	5	
1605	TEST #2										
	Door Point:	1	2	3	4	5	6	7	8	9	
	Reaction:	P	P	P	P	P	P	P	P	P	
	Time (Sec.)	2	3	1	3	2	2	4	4	3	
1625	TEST # 3										
	Door Point:	1	2	3	4	5	6	7	8	9	
	Reaction:	P	P	P	P	P	P	P	P	P	
	Time (Sec.)	3	2	2	6	2	5	7	4	3	

The above tests were conducted with the windows CLOSED.
The use time of the sensor was 2 hours 20 minutes.

TEST SHEET # 3

DATE: January 17, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 4 oz. dextrose added to previous mix. (Sheet 1 & 2)

Time

1750

TEST # 1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	P	P	N	P	P	P
Time (Sec.)	2	2	4	7	5	10	5	4	3

P- Positive
N- No response

1810

TEST # 2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	P	P	P	P	P	P
Time:(sec)	~~3~~ 3	~~3~~ 3	~~3~~ 3	~~10~~ 6	~~7~~ 9	~~3~~ 3	~~3~~ 3	~~5~~ 5	~~3~~ 3

1825

TEST # 3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	~~N~~	P	P	P	P	P
Time (sec)	3	3	3	10	7	3	3	3	2

The above tests were conducted with the windows CLOSED.
The use time of the sensor 55 minutes.

In the above test dextrose is used in place of the mannite.
All materials were mixed together.

TUESDAY, JANUARY 18, 1972

Time	
0945	Detector stabilized.
1000	Detector indicated positive response to heroin supply.
1005	Test room monitored - strong negative response in toilet area. Window in toilet opened to create a draft. 8 "false alarms" recorded within the test room while it was being monitored, 4 with window open, 4 with window closed.
1015	Room damp mopped to hold down dust.
1030	Detector stabilized in the hallway. Door monitored and hit positive at points 3 & 8.
1045	Personell monitored, materials monitored - no response.
1100	Team entered room to begin cutting operation.
1130	Mix #1 completed, team left the room.
1145	Test #1 conducted. (See test sheet #1, 1-18-72).
1200	Test #2 do do
1215	Test #3 do do
5	Sensor changed.
1230	Team entered for mix #2.
1240	Alarm sounded while unit in the hallway approximately 10 feet from test room.
255	Same as 1240
1305	Team completed mix #2 and left room.
1320	Test #1 conducted. (See test sheet #2, 1-18-72).
1335	Test #2 do do
1350	Test #3 do do
1415	Pump removed and cleaned and replaced.
1430	Sensor installed.
1440	Team entered room for mix #3.
1445	Sensor stabilized.

Time			
1520	Team completed mix #3.		
1535	Test #1 conducted. (See test sheet ##3, 1-18-72).		
1550	Test #2	do	do
1615	Test #3	do	do
1630	Testing concluded.		

TEST SHEET # 1

DATE: January 18, 1972 OUTSIDE TEMP: 29 deg. HUMIDITY: 56%
TYPE: Simulated heroin cutting factory
PLACE: Fort Totten, NY, Bldg. 318

MATERIALS: 4 oz. heroin, 4 oz. quinine, 16 oz. dextrose
TEMPERATURE: 72 degrees
HUMIDITY: 12%

P - Positve
N - No response
Neg - Negative

Time	TEST #1									
1145	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	P	N	N	Neg	Neg	Neg	N	Neg
	Time (Sec):	10	9	10	10	10	10	10	10	10

	TEST # 2									
1200	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	Neg.	Neg	Neg	N	N
	Time:	10	10	10	10	10	10	10	10	10

	TEST #3									
1215	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	P	P	Neg	Neg	Neg	Neg	N
	Time (sec)	10	10	3	6	10	10	10	10	10

The above tests were conducted with the windows OPEN to create a draft.
The use time of the sensor in these tests was 2 hours 40 minutes
Dextrose is being used in place of mannite which was used in two of the tests conducted on the previous day.

TEST SHEET # 2

DATE: January 18, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 4 oz. dextrose added to mix on Sheet #1.

TEMP. 76 deg.
HUM. 13%

Time
1320

TEST # 1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	P	P	Neg	Neg	Neg	Neg	N	Neg
Time (Sec):	10	2	6	10	10	10	10	10	10

1335

TEST # 2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	N	Neg	Neg	Neg	Neg	Neg	N	Neg
Time (Sec):	10	10	10	10	10	10	10	10	10

1350

TEST # 3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	N	N	Neg	Neg	Neg	Neg	N	N
Time (Sec):	10	10	10	10	10	10	10	10	10

The above tests were conducted with the windows OPEN
The use time of the sensor was 1 hour 35 min.

TEST SHEET # 3

DATE: January 18, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 4 oz. dextrose added to the mix. (Sheets 1 & 2)

TEMP. 75 degrees
HUM. 15%

Time

1535 TEST # 1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	N	P	N	Neg	Neg	P	P	N
Time(sec):	7	10	4	10	10	10	7	7	10

P - positive
N - no response
Neg - negative

1550 TEST # 2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	P	Neg	Neg	N	P	N
Time (sec):	5	9	6	6	10	10	10	9	10

1615 TEST # 3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	Neg	N	N	N	N
Time (sec):	3	3	4	10	10	10	10	10	10

The above tests were conducted with the window OPEN

The use time of the sensor was 1 hour 45 min.

Time

1205 Sensor installed.

1200 New sensor installed due to numerous positive and negative responses indicating that the 1st sensor was unstable.

1215 Sensor stabilized.

1217 Positive response to heroin supply.

1220 Test room monitored - strong negative response in toilet area. Fluctuations between positive and negative in the test room.

1230 Door monitored and indicated at points as shown below:

1	2	3	4	5	6	7	8	9
P	P	N	Neg	P	P	N	N	P
P	P	P	Neg	P	P	P	P	P

P - positive
N - no response
Neg negative
(variable pump speed was noted during the above monitoring)

1330 Pump cleaned.
Door wiped down with a wet sponge due to numerous positive responses at 1230.
Sensor changed and stabilized.

1340 Door monitored as below:

1	2	3	4	5	6	7	8	9
P	N	N	N	N	N	N	N	N

P - positive
N - no response

1350 Heroin indicated positive signal against new sensor installed at 1330.

1400 Personnel and materials monitored - no response.
Team entered room for mix #1.

1430 Test while team in room and mixing:

1	2	3	4	5	6	7	8	9	- Door Point
P	P	N	N	N	N	N	N	N	- Reaction
10	8	10	10	10	10	10	10	10	- Time (sec)

P - Positive
N - no response

1435 Mix #1 completed, team left room.

1450 Test #1 conducted. (See test sheet #1, 1-19-72)

1505 Test #2 do do

1525 Test #3 do do

1525 Sensor changed and stabilized after test #3.

1530 Team in room for mix #2.

1605 Test while team in room:

Door Point	1	2	3	4	5	6	7	8	9
Reaction	P	P	P	N	P	P	P	P	P
Time (Sec.)	2	2	3	10	2	2	3	3	2

1615 Team left the mix room.

Time

1630 Test #1 conducted. (See test sheet #2, 1-19-72).

1645 Test #2 do do

1700 Test #3 do do

1705 Team entered for mix #3.

1730 Battery pack changed. (Pump appered to be slowing).

1740 Test while team in room mixing:

Door Point	1	2	3	4	5	6	7	8	9
Reaction	N	N	N	N	N	N	N	N	N
Time (Sec.)	10	10	10	10	10	10	10	10	10

1745 Sensor changed.

1752 Stabilized.

1755 Team in room:

Door Point	1	2	3	4	5	6	7	8	9
Reaction	P	P	P	N	N	P	P	P	N
Time (sec.)	5	3	8	10	10	3	4	2	D0

1800 Team left room.

1815 Test #1 conducted. (See test sheet #3, 1-19-72).

1835 Test #2 do do

1855 Test #3 do do

1910 Testing concluded.

TEST SHEET # 1

DATE: January 19, 1972 OUTSIDE TEMP: 47 deg. HUMIDITY: 56%

TYPE: Simulated heroin cutting factory.

PLACE: Fort Totten, NY, Bldg. 318

MATERIALS: 1 oz. heroin, 1 oz. quinine, 3 oz. lactose.

TEMP: 72 degrees
HUM: 23%

Time
1450 TEST # 1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	N	N	N	N	N	N	N	N
Time (sec):	10	10	10	10	10	10	10	10	10

P - positve
N - no response
Neg - negative

1505 TEST # 2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	N	P	N	N	N	N	N	Neg
Time (sec):	10	10	6	10	10	10	10	10	10

1525 TEST # 3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	N	N	N	N	N	N	N	N
Time (Sec):	10	10	10	10	10	10	10	10	10

The above tests were conducted with thw window CLOSED
The use time of the sensor was 2 hours.
Lactose was used in the mix as opposed to dextrose or mannite on previous days mixes.
1 ounce heroin used on the first mix as opposed to 4 ounces used on the first mix of the previcus days.

TEST SHEET # 2

DATE: JAN. 19, 1972

MATERIALS: 1 oz heroin 1 oz quinine, 3 oz lactose added to mix #1
TEMP: 71 deg.
HUM. 21%

ime

1630 TEST # 1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	P	P	P	P	P
Time (sec):	2	4	4	10	4	5	7	7	9

1645 TEST # 2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	N	N	P	N	N	N	P
Time (sec):	2	4	10	10	10	10	10	10	9

1700 TEST # 3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	N	N	N	N	N	N	N	P
Time (sec):	9	10	10	10	10	10	10	10	7

The above tests were conducted with the window CLOSED

The use time of the sensor was 2 hours 20 min.

TEST SHEET # 3

DATE: January 19, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 3 oz. lactose added to mix #1 & #2.

TEMP: 70 deg.

HUM: 21%

Time

1815 TEST # 1

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	N	N	N	N	N
Time (sec):	6	6	7	10	10	10	10	10	10

1835 TEST # 2

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	P	N	N	N	N	N	N	N
Time (sec):	10	8	10	10	10	10	10	10	10

1855 TEST # 3

Door Point:	1	2	3	4	5	6	7	8	9
Reaction:	N	N	P	N	N	Neg	N	N	N
Time (sec):	10	10	7	10	10	10	10	10	10

The above tests were conducted with thw window CLOSED

The use time of the sensor was 1 hour 15 min.

The battery pack was changed on the unit at 1730 hours between test sheet #2 & test sheet #3.

TEST SHEET # 3

DATE: January 24, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 4 oz dextrose added to mix # 1 & 2

TEMPERATURE: 58 deg.

HUMIDITY: 39%

Time										
1710	TEST # 1									
	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	N	Neg	N	N	P
	Time (sec):	10	10	10	10	10	10	10	10	8
1725	TEST # 2									
	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	N	N	N	N	N
	Time:(sec):	10	10	10	10	10	10	10	10	10
1740	TEST # 3									
	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	Neg	N	Neg	Neg	N	Neg	N
	Time (Sec):	10	10	10	10	10	10	10	10	10

The above tests were conducted with thw window OPEN.

The use time oft he sensor was 1 hour 30 minutes.

P - Positivo
N - no response
Neg - negative

TEST SHEET # 2

DATE: January 24, 1972

MATERIALS: 1 oz. heroin, 1 oz. quinine, 4 oz. dextrose

TEMPERATURE: 60 degrees
HUMIDITY: 40%

Time	TEST # 1								
1525	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	Neg	Neg	Neg	N	N
	Time (sec):	10	10	10	10	10	10	10	10	10

1540	TEST # 2								
	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	Neg	Neg	Neg	Neg	N
	Time: (sec)	10	10	10	10	10	10	10	10	10

1555	TEST #3								
	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	Neg	N	N	N	N	N
	Time (sec):	10	10	10	10	10	10	10	10	10

The above tests were conducted with the window OPEN.

The use time of the sensor was 1 hour 40 minutes.

TEST SHEET # 1

DATE: January 24, 1972 OUTSIDE TEMP: 46 deg. HUM: 58%
TYPE: Simulated heroin factory
PLACE: Fort Totten, NY, Bldg. #318

MATERIALS: 4 oz. heroin, 4 oz. quinine, 16 oz. dextrose
TEMPERATURE: 60 degrees
HUMIDITY: 40 %

Time										
	TEST # 1									
1350	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	Neg	N	Neg	N	N
	Time (sec):	10	10	10	10	10	10	10	10	10
1410	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	N	N	N	N	Neg	N	N	N
	Time (sec):	10	10	10	10	10	10	10	10	10
1425	TEST # 3									
	Door Point:	1	2	3	4	5	6	7	8	9
	Reaction:	N	Neg	N	N	N	N	Neg	Neg	Neg
	Time (Sec):	10	10	10	10	10	10	10	10	10

The above tests were conducted with the window open.

The use time of the sensor was 2 hours.

MONDAY, JANUARY 24, 1972

Time	
1030	Detector appeared sluggish due to long exposure to outside temperature and humidity.
1215	Detector placed in the hallway outside the test room.
1230	Unit stabilized.
1235	Unit registered positive against heroin supply.
1240	Test room monitored and registered negative in the toilet area. No false alrms in the test room.
1243	Door points monitored - negative at ponits 5, 6 & 9.
1245	Personnel and materials monitored - no response.
1250	Team entered test room for mix #1.
1335	Team finished mix and left the test room.
1350	Test #1 conducted. (See test sheet #1, 1-24-72).
1410	Test #2 do do
1425	Test #3 do do
430	Sensor changed - team entered room for mix #2.
1443	Unit stabilized.
1510	Team completed mix #2 and left the test room.
1525	Test #1 conducted. (See test sheet #2, 1-24-72).
1540	Test #2 do do
1555	Test #3 do do
1610	Team entered room for mix #3.
1610	Sensor changed.
1620	Sensor stabilized.
1655	Mix completed, team left room.
1710	Test #1 conducted. (See test sheet #3, 1-24-72).
1725	Test #2 do do
1740	Test #3 do do
1745	Testing concluded.

TUESDAY, JANUARY 25, 1972

Time

1400 The following test was conducted to ascertain if similar reaction was obtained to the residual effect of the heroin as recorded 1230 Jan. 19, 1972. No mixing was conducted in the test room today.

1420 Sensor installed. Four minutes to stabilize.

1425 Detector was placed in the hallway outside the test room and a strong negative response was indicated. (Probably due to the stairwell adjacent to the test area being mopped with an ammonia cleansing solution.

1435 Unit stabilized again.

1435 Door monitored at test points and responded as indicated:

Door point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	Neg	P	P	N	P	P
Time (sec.):	6	4	5	10	6	7	10	3	2

N - no reponse
P - positive
Neg - negative

1455 Door monitored:

Door point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	P	P	N	P	P
Time (Sec.):	2	2	2	10	9	3	10	5	3

1500 Door wiped down with a wet sponge.

15 Door monitored:

Door point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	P	N	P	P	P	N	P
Time (sec.)	4	3	7	10	7	4	6	10	4

1520 Residue from the previous days mixing operation was apparent on the tables and they were wiped down with a wet sponge and the windows were opened to allow the room to air.

1535 Windows were closed.

1540 Door monitored:

Door point:	1	2	3	4	5	6	7	8	9
Reaction:	P	P	N	N	N	N	N	N	N
Time (sec.):	9	7	10	10	10	10	10	10	10

1545 Door monitored:

Door point:	1	2	3	4	5	6	7	8	9
Reaction:	N	P	N	N	N	N	N	N	N
Time (sec.):	10	7	10	10	10	10	10	10	10

1600 Testing concluded.

APPENDIX B

Wall Tests and Seizures

(New York City Police Department Records)

and

Explosives Detector Evaluations

(New York City Police Department Records)

December 31, 1971

This test was conducted by inserting the probe through a hole in the top of three empty "tulip cups" (labeled A, B, & C) and sampling the inside of the containers for approximately twenty-five seconds. Without any response noted this officer then removed the top of container "A" and placed eight plastic bags and fifty-eight glassine envelopes each containing a white powder (alleged heroin) inside and replaced the top of this "tulip cup". B & C cups were then resampled for response by the instrument (blue model) and without noting any, the probe was reinserted into container "A". After a period of five seconds the instrument's alarm sounded indicating the presence of heroin vapors within the container. The subject material (plastic bags & glassine envelopes) was then removed from "A" and placed into cup "B". "A" was then aired out and both tops were replaced on each container and the second test was then conducted. "C" & "A" were then sampled each in turn without response and then "B" (which contained the alleged heroin) responded by sounding the alarm after the probe had been inserted over a period of eight seconds. "B" was then emptied and aired out with the contents being placed in "C" for the third test. This test resulted in "A" & "B" not responding and "C" sounding the alarm after twelve seconds. The following tests were conducted following the exact processure as mentioned above.

TEST TYPE: Field (inside)
PLACE: 52 Pct. Station House
DATE: December 31, 1971
TIME: 0100 hrs
WEATHER: Rain
ROOM TEMP: 78 degrees
ARREST NUMBERS: 1011 thru 1018
PCT. VOUCHER: 818
LAB NO. & ANALYSIS

TEST #3
TIME 0120 hrs
CONDUCTED BY Det. Edward Wilson #109 S.I.U. Narc. Div.
CONTAINER A....Alarm (7 seconds).....ALLEGED HEROIN

B....No response.....Empty Container

C....No response.....Empty Container

TEST #3
TIME 0130 hrs
CONDUCTED BY Ptl Vincent Santangelo #5938
CONTAINER A....No response.....Empty Container

B....Alarm (6 seconds).....ALLEGED HEROIN

C....No response.....Empty Container

TEST #4
TIME 0135
CONDUCTED BY Ptl. Vincent Santangelo #5938
CONTAINER A....No response.....Empty Container

B....No response.....Empty Container

C....Alarm (5 seconds).....ALLEGED HEROIN

TEST #5
TIME 0145
CONDUCTED BY Det. Edward Wilson #109 S.I.U. Narc. Div.
CONTAINER B....No response.....Empty Container

A....No response.....Empty Container

C....Alarm (7 seconds).....ALLEGED HEROIN

TEST #6
TIME 0155 hrs
CONDUCTED BY Det. John Hennessey #16008 52nd Sqd.
CONTAINER A....No response.....Empty Container

B....No response.....Empty Container

C...Alarm (4 seconds).....ALLEGED HEROIN

TEST #7
TIME 0205 hrs
CONDUCTED BY Ptl. Donald Siebold #25718 ND #9
CONTAINER B....No response.....Empty Conatiner

A....Alarm (5 seconds).....ALLEGED HEROIN

C....No response.....Empty Container

TEST # 8
TIME 0215 hrs
CONDUCTED BY Ptl. Richard Stewart #11378 52 Pct
CONTAINER
A....No response.....Empty Container

C....No response.....Empty Container

B....Alarm (15 seconds).....ALLEGED HEROIN

TEST # 9
TIME 0330 hrs
CONDUCTED BY Ptl. Donald Siebold #25718 ND 9
CONTAINER
A....No response.....Empty Container

C....Alarm (13 seconds).....ALLEGED HEROIN

B....No response.....Empty Container

TEST #10
TIME 0340 hrs
CONDUCTED BY Det. Edward Wilson #109 S.I.U. Narc. Div.
CONTAINER
C....No response.....Empty Container

B....No response.....Empty Container

A....Alarm (9 seconds).....ALLEGED HEROIN

DECEMBER 31, 1971 (3nd CALL)

TEST TYPE: Field (inside)
PLACE: 1827 Madison Ave. (Grocery Store)
DATE: 12-31-71
TIME: 1800 hrs
WEATHER: Damp
ROOM TEMP: 75 degrees
ARREST NUMBERS:
PCT. VOUCHER:
LAB NO. & ANALYSIS:

1800 hrs. Det. Edward Wilson #109 S.I.U. Narc. Div. responded to 1827 Madison Ave. and while there in the presence of Lt. Herbert Kohlman, Narcotics Div. and members of the Emergency Service Div. conducted a test on a safe located therein. The safe approximately 30 inches high, 34 inches wide and 34 inches deep. A probe was inserted into a 2 inch square hole and a sample of the vapors resulted in the instrument's alarm sounding, denoting the presence of heroin. This procedure was repeated twice with the same results. Subsequent search of the safe revealed several manila envelopes each containing a white powder (alleged heroin). Further search of said premises revealed other packages of white powder also alleged heroin. All of the seized property was taken to the 25th Pct. station house where the following tests were conducted.

TEST #1
TIME 2005
PLACE 25th Pct. Station House
CONDUCTED BY Lt. Feeley Narc. Div.
TYPE OF TEST "Tulip Cup" test as previously described
CONTAINER

A....Alarm (11 seconds).....Alleged Heroin

B....No response.....Empty Container

C....No response.....Empty Container

TEST # 2
TIME 2015
CONDUCTED BY Lt. Feeley Naro. Div.
CONTAINER A....No response.....Empty Container

B....Alarm (13 seconds).....Alleged Heroin

C....No response.....Empty Container

TEST # 3
TIME 2035
CONDUCTED BY Det. Anthony Altomare # 400 25th St.
CONTAINER A....No response.....Empty Container

B....No response.....Empty Container

C....Alarm (10 seconds).....Alleged Heroin

The above tests were conducted on the Blue Instrument Machine

GOLD MACHINE

TEST # 4
TIME 2040
CONDUCTED BY Det. Fred Cappetta #537 25th St.
CONTAINER C....Alarm (12 seconds).....Alleged Heroin

B....No response.....Empty Container

A....No response.....Empty Container

TEST # 5
TIME 2050
CONDUCTED BY Ptl. Ralph Decollibus #10666 ND #3
CONTAINER A....No response.....Empty Container

C....No response.....Empty Container

B....Alarm (9 seconds).....Alleged Heroin

TEST # 6
TIME 2100
CONDUCTED BY Clifford Fishman, Asst. Dist. Att., Manhattan
CONTAINER

A....No response.....Empty Container

C....No response.....Empty Container

B....Alarm (19 seconds).....Alleged Heroin

TEST # 7
TIME 2105
CONDUCTED BY Sgt. James Belman #119 ND #3
CONTAINER

B....No response.....Empty Container

C....No response.....Empty Container

A....Alarm (14 seconds).....Alleged Heroin

January 3, 1972

TEST TYPE: Lab (inside)
PLACE: Police Academy
DATE: January 3, 1972
TIME: 1630 hrs
ROOM TEMP.: 75 degrees

The following tests were conducted by Det. Edward Wilson using the bulk heroin Bronx Voucher #70B 18471 and "street bags" Manhattan Vouchers #71N 11800 and #71N 11875. The combined weight of the above is approximately one pound.

TEST #1
TIME 1650 hrs
CONDUCTED BY Det. Edward Wilson #109 S.I.U. Narc. Div.
TYPE OF TEST "Tulip Cup" test as previously described
CONTAINER

A....Alarm (10 seconds)..... Heroin

B....No response..... Empty Cup

C....No response..... Empty Cup

TEST #2
TIME 1705 hrs
CONTAINER

A....No response..... Empty Cup

B....Alarm (8 seconds)..... Heroin

C....No response..... Empty Cup

TEST #3
TIME 1720 hrs
CONTAINER

A....No response..... Empty Cup

B....No response..... Empty Cup

C....Alarm (22 seconds)..... Heroin

TEST #4
TIME 1805 hrs.
CONTAINER Cardboard box - 6"x8"x10" --- Alarm 6 seconds

TEST #5
TIME 1820 hrs
CONTAINER Cardboard box - 6"x8"x10" --- Alarm 4 seconds

TEST #6
TIME 1950 hrs
CONTAINER — Suitcase - 28"x18"x8" --- Alarm sounded after two minutes of placing probe along the seam of the suitcase

TEST #7
TIME 2010 hrs
CONTAINER — Suitcase above --- Alarm sounded after 16 attempts at keyhole

TEST #8
TIME 2050 hrs
CONTAINER — Suitcase above --- Alarm sounded 4 seconds after prying suitcase seam with a screw driver and inserting probe next to screw driver

TEST #9
TIME 2135 hrs
CONTAINER — Metal desk drawer --- Alarm sounded after three minutes of placing probe along the outside edges of the drawer. The alarm sounded when placed in the top right corner of drawer

TEST #10
TIME 2230 hrs
CONTAINER — Suitcase mentioned above --- Alarm sounded after numerous attempts by placing probe along outside seam of suitcase. The alarm sounded when suitcase was pried open with a screw driver

TEST #11
TIME 2310 hrs
CONTAINER — Large cardboard box - 15"x15"x15" --- Ten unsuccessful attempts at various intervals by placing probe into hole located 1½" from the top.

TEST #12
TIME 2335 hrs
CONTAINER — Large cardboard box above --- Alarm sounded after placing probe into hole 2" from bottom

January 4, 1972

TEST TYPE: Lab (inside)
PLACE: Police Academy
DATE: January 4, 1972
TIME: 1640 hrs
ROOM TEMP.: 75 degrees

The following tests were conducted by Det. Edward Wilson using the bulk heroin Bronx Voucher # 70B 18471 and "street bags" Manhattan Vouchers #71N 11800 and #71N 11875. The combined weight of the above is approximately one pound.

TEST #1
TIME 1705 hrs
CONDUCTED BY Det. Edward Wilson #109 S.I.U. Narc. Div.
TYPE OF TEST "Tulip Cup" test (street bags only)
CONTAINER

A...No response..... Empty Cup

B...No response..... Empty Cup

C...Alarm (15 seconds)..... Heroin

TEST #2
TIME 1720 hrs
CONTAINER

A...Alarm (18 seconds)..... Heroin

B...No response..... Empty Cup

C...No response..... Empty Cup

TEST #3
TIME 1735 hrs
CONTAINER

A...No response..... Empty Cup

B...Alarm (9 seconds)..... Heroin

C...No response..... Empty Cup

TEST #4
TIME 1845 hrs
CONTAINER Suitcase - 28"x18"x8" --- Using a negative "bug" alarm sounded three times on key hole test at various intervals during numerous tests
The above bulk heroin had been in suitcase 22 hrs

TEST #5
TIME 1950 hrs
CONTAINER — Cardboard box 15"x15"x15" --- Using a negative "bug" Ptl Warren Tyranski Shield #24815, inserted the probe into a hole located 2" from the bottom which sounded the alarm

TEST #6
TIME 2015 hrs
CONTAINER — Cardboard box above --- Changing the negative sensor Det. Wilson after several attempts received similar results

TEST #7
TIME 2040 hrs
CONTAINER — Cardboard box above --- Using a positive sensor the alarm sounded after placing the probe into a hole located 1½" from the top

TEST #8
TIME 2115 hrs
CONTAINER — Metal desk drawer --- Alarm sounded at top right corner of the drawer after minutes of probing outside of drawer

TEST #9
TIME 2150 hrs
CONTAINER — Numerous unsuccessful attempts to detect vapors from hole in top of cardboard box 15"x15"x15"

TEST #10
TIME 2210 hrs
CONTAINER — Cardboard box above --- Alarm sounded when probe was placed into hole 2" from the bottom of the box

TEST #11
TIME 2305 hrs
CONTAINER — Mobile wall --- Unsuccessful attempts to detect vapors

JANUARY 5, 1972

TEST TYPE: Lab (inside)
PLACE: Police Academy
DATE: January 5, 1972
TIME: 1600 hrs.
ROOM TEMP: 76 degrees

TEST #1
TIME 1600 hrs
CONDUCTED BY Det. Edward Wilson #109, S.I.U. Narc. Div. in the presence of Senior Chemist Bass, Police Lab. and Mr. A. Enriguez of R.P.C. Corp.

CONTAINER Large brown paper bag containing heroin seized at 1837 Madison Ave., Manhattan on December 31, 1971. This seizure was previously tested and results noted in report of December 31, 1971. (2nd Call) 1600 hrs. After an elapsed time of 6 seconds after the probe had been inserted into this brown paper bag the alarm sounded indicating the presence of heroin vapors.

TEST #2
TIME 1840 hrs.
CONDUCTED BY Det. Wilson
CONTAINER Cardboard box 13"x15"x15" had been filled with bulk heroin (15oz.) and street bags and then sealed for approx. 3 and ½ hours for the vapors to build. Det. Wilson in the presence of Mr. A. Enriguez made a ¼ inch hole in the box approx. 8" from the subject material and recived an alarm after 16 seconds of the insertion of the probe.
1900 hrs Repeat of the above with a response time of 13 seconds.
1930 hrs. Probe reinsarted into box without a response after 20 seconds. The sensor was then examined and found to contain dust particles with the agar being concave in nature and void of culture.

TEST #3
TIME 2000 hrs
CONDUCTED BY Det. Wilson
CONTAINER "Tulip Cup"

A....Alarm (6 seconds).....Heroin

B....No response.....Empty Cup

C....No response.....Empty Cup

TEST # 4
TIME 2010 hrs
CONDUCTED BY Det. Wilson
CONTAINER

A....Alarm FALSE (3 seconds).....Empty Cup

B....Alarm (7 seconds).....Heroin

C....No response.....Empty Cup

A..No response after being washed and aired.

TEST #5
TIME 2315 hrs
CONDUCTED BY Det. Wilson
CONTAINER

Desk drawer of metal desk had been filled with bulk heroin (15 oz.) and street bags and a sampling of the outside of the drawer resulted in an alarm being sounded after 33 seconds of probing. The alarm responded after probe had been placed in the proxmity of the upper right corner of said drawer.

2305 hrs. Alarm sounded but test voided due to probe touching corner of drawer.

2310 hrs. Alarm sounded after 17 seconds of probing outside of drawer with the location being the same as above. (Top right corner)

THURSDAY January 6, 1972

TEST TYPE: Lab (inside)
PLACE: Police Academy
DATE: January 6, 1973
TIME: 1600 hrs
ROOM TEMP: 74 degrees

TEST #1
TIME 1600 hrs
CONDUCTED BY Lt. James McSloy, Planning Div.
TYPE OF TEST "Tulip Cup" test as previously described
CONTAINER
A....Alarm (4 seconds).....Heroin

B....No response.....Empty Cup

C....No response.....Empty Cup

TEST #2
TIME 1610 hrs
CONDUCTED BY Lt. James McSloy, Planning Div.
CONTAINER:
A....No response.....Empty Cup

B....Alarm (6 seconds).....Heroin

C....No response.....Empty Cup

TEST #3
TIME 1620 hrs
CONDUCTED BY Lt. James McSloy, Planning Div.
CONTAINER
A....No response.....Empty Cup

B....No response.....Empty Cup

C....Alarm (9 seconds).....Heroin

TEST #4
TIME 1630
CONDUCTED BY Sgt. John O'Friel, Planning Div.
CONTAINER
A....Alarm (4 seconds).....Heroin

B....No response.....Empty Cup

C....No response.....Empty Cup

TEST #5
TIME 1640
CONDUCTED BY — Sgt. John O'Friel, Planning Div.
CONTAINER

A....No response.....Empty Cup

B....Alarm (7 seconds).....Heroin

C....No response.....Empty Cup

TEST #6
TIME 1650
CONDUCTED BY — Sgt. John O'Friel, Planning Div.
CONTAINER

A....No response.....Empty Cup

B....No response.....Empty Cup

C....Alarm (9 seconds).....Heroin

TEST #7
TIME 1730
TYPE OF TEST

At this time Det. Edward Wilson #109 S.I.U. Narc. Div. inserted the bulk heroin in street bags onto the top shelf of metal storage cabinet size 7'X20"X38" 1900 hrs. Alarm sounded after insertion of probe into louvred opening at front of cabinet in close proximity to heroin on top shelf.
1905 hrs. Alarm responded 10 seconds after re-insertion into louvred opening.
1915 hrs. The above mentioned test was conducted WITHOUT RESPONSE by Senior Chemist Bass, Police Lab. Subsequent removal and inspection of the used sensor indicated the presence of several large dirt particles on the inoculated surface of the subject sensor.
2000 hrs. After changed sensor had been stabilized Sgt. Harry Cruse #153, Police Lab, inserted the probe into the louvred opening and received an alarm after 14 seconds of insertion.
2015 hrs. Ptl. Gerald Donohue #11959, Forensic Unit received an alarm after 11 seconds following insertion of probe.
2345 hrs. Det. Wilson in the presence of A. Enriguez of R.P.C. Corp. inserted probe into louvred opening of metal wall locker and received an alarm after 17 seconds of insertion from the bulk heroin located on a shelf 30" below the probe.
2335 hrs. Repetition of the above after 13 seconds of the insertion of the probe.

JANUARY 14, 1972

TEST TYPE: Field (inside)
PLACE: 75th Pct. Station House
DATE: January 14, 1972
TIME: 0100 hrs
WEATHER: Rain
ROOM TEMP.: 73 degrees
ARREST NOS. 368 and 369
PCT. VOUCHER:
LAB NO. & ANALYSIS

TEST #1
TIME 0100 hrs
CONDUCTED BY Det. Ray Sheerin #728 12DD Robbery
CONTAINER "Tulip Cup"
SUBJECT MATERIAL Plastic bag 1 lb. white powder alleged heroin

A....Alarm (4 seconds).....Alleged heroin

B....No response.....Empty Cup

C....No response.....Empty Cup

TEST #2
TIME 0115
CONDUCTED BY Det. Henry O'Brien #1738 12DD Robbery

A....No response.....Empty Cup

B....Alarm (7 seconds).....Alleged heroin

C....No response.....Empty Cup

TEST #3
TIME 0145
CONDUCTED BY Ptl. Thomas Dugan #26890 A.I.S.

A....No response.....Empty Cup

B....No response.....Empty Cup

C....Alarm (6 seconds).....Alleged heroin

TEST #4
TIME 0155
CONDUCTED BY Ptl. Thomas Peterson #22538 A.I.S.

A....Alarm (9 seconds).....Alleged heroin

B....No response.....Empty Cup

C....No response.....Empty Cup

TEST #5
TIME 0220
CONDUCTED BY Det. Ray Sheerin #739 12DD Robbery

A....No response.....Empty Cup

B....Alarm (9 seconds).....Alleged heroin

C....No response.....Empty Cup

TEST #6
TIME 0245
CONDUCTED BY Det. Henry O'Brien #1798 12DD Robbery

A....No response.....Empty Cup

B....No response.....Empty Cup

C....Alarm (6 seconds).....Alleged heroin

EXPLOSIVES DETECTOR EVALUATION TESTS
BOMB SECTION
NEW YORK CITY POLICE DEPARTMENT

FEDERAL GRANT # C-55684

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Sect. Office

Time 1400 hours Date 1/31/72 Weather _____

Sensor # 2197 Bottle # 1412/1373 ACT. 1/25/72

Sensor Test ok Sensor condition ok

Stabilization time 6 min.

Test Material 4 oz granular 40% dupont dynamite

Control test ok

Type of Containor Safe deposit box

Location of Explosive in Containor exposed in box

Listance (probe to test material) edge of box

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS,

No Test ---- Battery pack trouble

TEST OFFICER

[signature]

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Sect. Office

Time 0900 Date 1/31/72 Weather _____

Sensor # 1923/1927 Bottle # 1412/1373 Act 1/25/72

Sensor Test ok Sensor condition ok

Stabilization time 10-12 min.

Test Material 4 oz. 40 % Dupont Gel Dynamite

Control test ok

Type of Container Safe Deposit Box

Location of Explosive in Container Granular in plastic bag (open)

Listance (probe to test material) at opening

Sampling Time

Test # 1	20 sec.	5	
2		6	
3		7	
4		8	

Response: Test # all Time within 20 sec.

REMARKS,

Dynamite was placed in box 48 hours prior to test. Flat probes were erratic, in almost every test they caused the instrument to register on the positive side. Results were received using round probes.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Sect. Office

Time 1100 Date 1/20/72 Weather _____

Sensor # 2197 Bottle # 1412 Act 1/20/72

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 8 oz. 40 % Dupont Gel Dynamite

Control test ok

Type of Containor exposed

Location of Explosive in Containor _____

Listance (probe to test material) 2 in.

Sampling Time

Test #	1	10 sec.	5	do
	2	do	6	do
	3	do	7	do
	4	do	8	do

Response: Test# all test Time 5 to 10 sec.

REMARKS,

Dynamite was removed from the wrapper, crushed to a granular form and placed in a dish. probe was placed 2" above the dish.

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Sect. Office

Time 1100 Date 1/29/72 Weather _____

Sensor # 2197 Bottle # 1412 Act 1/20/72

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 8 oz. 40 % Dupont Gel Dynamite

Control ok

Type of Containor exposed

Location of Explosive in Containor _____

Listance (Distance to test material) 2 in.

Sampling

Test # 1	10 sec.	5	do
2	do	6	do
3	do	7	do
4	do	8	do

Response: Test # all test Time 5 to 10 sec.

REMARKS,

Dynamite was removed from the wrapper, crushed to a granular form and placed in a dish. probe was placed 2" above the dish.

TEST OFFICER

Gilman

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Sect. Office

Time 1100 Date 1/28/1972 Weather _____

Sensor # 2197 Bottle # 11.12/1323 Act 1/19/72

Sensor Test ok Sensor condition ok

Stabilization time 10 to 15 min.

Test Material 40 % Dupont Gel Dynamite

Control test Very Sluggish

Type of Containor _____

Location of Explosive in Containor _____

Listance (probe to test material) _____

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

Heroin instrument being used at this time. Apparently having sensor problems. Sensor sluggish on blue instrument also.

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Sect. Office

Time 1030 hours Date 1/27/72 Weather _____

Sensor # 2197 Bottle # 1412/1323 Act. 1/11/72

Sensor Test ok Sensor condition ok

Stabilization time 3 min.

Test Material 40 % dupont Gel Dynamite

Control test ok

Type of Container _____

Location of Explosive in Container _____

Listance (probe to test material) _____

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

No Test ---- Electronic problems. Meter rapidly fluxuating between plus and minus.

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1700 Date 1/25/72 Weather _____

Sensor # 2107 Bottle # 1323 act. 1/18

Sensor Test ok Sensor condition ok

Stabilization time 6 min.

Test Material 1 stick, 1/2" Dupont 1C 6" Gel Dynamite (primadan)

Control test ok

Type of Containor Wood box, covered and wrapped.

Location of Explosive in Containor _____

Listance (probe to test material) inserted thru hole

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

Explosive in box 70 hours
8 tests conducted, immediate response in all tests.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0900 Date 1/31/72 Weather _____

Sensor # 3177 Bottle # 1373 act. 1/16

Sensor Test ok Sensor condition ok

Stabilization time 1 min

Test Material 1 stick, 1/2 lb Dupont 100% Gel Dyne dynamite (granular)

Control test ok

Type of Container shoe box, covered, not wrapped

Location of Explosive in Container _____

Distance (probe to test material) at lid

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosive in box 15 hours
8 tests conducted with probe at lid, identification made in all 8 tests within 5 to 10 seconds.

TEST OFFICER

GReason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1300 Date 1/23/72 Weather _____

Sensor # 3197 Bottle # 1373 act. 1/10/72

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 1 stick 1/2lb Dupont 40 % Gel Dynamite (granular)

Control test ok

Type of Containor shoe box, covered, not wrapped

Location of Explosive in Containor _____

Listance(probe to test material) 2" from lid

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosive in box 2 hours
8 2 minute tests, no results

TEST OFFICER

Clemson

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 Date 1/21/72 Weather _____

Sensor # 2197 Bottle # 1373 act. 1/10

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 1 stick, 1/2lb Dupont 40 % Gel Dynamite(stick form)

Control test ok

Type of Containor cbon box, covered, not wrapped

Location of Explosive in Containor _____

Listance(probe to test material) at lid

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

Explosive in box 26 hours
8 tests were made passing the probe around the lid of the box, in all 8 tests there was a response in from 10 to 15 seconds.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 Date 1/20/72 Weather _____

Sensor # 2127 Bottle # 1373 act. 1/10

Sensor Test ok Sensor condition ok

Stabilization time 7 min.

Test Material 1 stick, 1/2lb Dupont AO5 Gel Dynamite(stick form)

Control test ok

Type of Container shoe box, covered, not wrapped

Location of Explosive in Container _____

Listance(probe to test material) 2" from lid

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS,

Explosive in box 2 hours.
8 2 minute test, no results

TEST OFFICER

Gleason

1/13

Jan 13
to Jan 19th

1/14

No Test

1/15

Due

to

1/17

flu

1/19

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1800 Date 1/12/72 Weather _____

Sensor # 2197 Bottle # 1373 act. 12/29/72

Sensor Test ok Sensor condition ok

Stabilization time 7 min.

Test Material 2 sticks, 1lb Dupont 40% Gel Dynamite(granular)

Control test ok

Type of Containor 5" attache case

Location of Explosive in Containor _____

Listance(probe to test material) Probe inserted into bag

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS,

Explosives in case 56 hours.
8 tests conducted, in each test the probe was inserted into the case, in all 8 tests the response time was less than 5 seconds.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0900 Date 1/10/72 Weather _____

Sensor # 2197 Bottle # 1373 act. 12/29/71

Sensor Test ok Sensor condition ok

Stabilization time 4-6 minutes

Test Material 2 sticks, 1lb Dupont 40% Gel Dynamite (Granular)

Control test ok

Type of Containor 5" attach case

Location of Explosive in Containor _____

Listance (probe to test material) outside case

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS,

Granular Dynamite in petri dish placed in case 24 hours prior to test.

8 three minute tests conducted, probe passed around outside of case.

No Results

TEST OFFICER

Clawson

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1700 Date 1/9/72 Weather _____

Sensor # 3197 Bottle # 1373 exch. 12/29/72

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 2 sticks, 1lb Dupont 40% Gel Dynamite

Control test ok

Type of Containor 5" attache case

Location of Explosive in Containor _____

Listance (probe to test material) probe inserted into bag.

Sampling Time

Test # 1	5-10 sec.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosive in bag 56 hours
Identification made within 5 to 10 seconds in 8 consecutive tests.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

ion of Test

1600 Date 1/7/72 Weather _____

2197 Bottle # 1373 act. 12/29/71

Test ok Sensor condition ok

ization time 6 min.

aterial 2 sticks, 1lb 40% Dupont Gel Dynamite (stick form)

ol test ok

of Container 5" attache case

ion of Explosive in Container _____

nce (probe to test material) outside seam

ing Time

Test # 1 _____ 5 _____

2 _____ 6 _____

3 _____ 7 _____

4 _____ 8 _____

nse: Test # _____ Time _____

KS,

Explosive in case 24 hours
8 three minute tests
No response

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0900 Date 1/6/72 Weather _____

Sensor # 2197 Bottle # 1373 act. 12/29/71

Sensor Test ok Sensor condition ok

Stabilization time 6 min.

Test Material 1 oz. IRE Dupont Gel Dynamite (1/2 stick)

Control test ok

Type of Containor 4" X 4" X 4" cardboard box wrapped in brown paper.

Location of Explosive in Containor _____

Listance (probe to test material) contact

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosive in box 46 hours.
Probe placed thru hole in box
8 tests were conducted, a signal was recorded in all 8 tests within 5 seconds.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 Date 1/5/73 Weather _____

Sensor # 2197 Bottle # 1373 ect. 12/29/72

Sensor Test ok Sensor condition ok

Stabilization time 4-6 min.

Test Material 4 oz. Dupont 40% Gel Dynamite (1/2 stick)

Control test ok

Type of Containor 4" X 5" X 4" cardboard box wrapped in brown paper

Location of Explosive in Containor _____

Listance (probe to test material) folds of package

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosive in box 34 hours.
8 3 min. tests were conducted, probe was held to and placed within the folds of the package. There were positive meter readings but no negative explosive signal.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0930 Date 1/4/72 Weather _____

Sensor # 2197 Bottle # 1373 exp. 12/29/72

Sensor Test ok Sensor condition ok

Stabilization time 7 min.

Test Material 4 oz. 40% Dupont Gel Dynamite (1/2 stick)

Control test ok

Type of Containor 4"x4"x4" cardboard box, wrapped in brown paper

Location of Explosive in Containor _____

Listance (probe to test material) outside but within 1" of box

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosive in box 30 min.
Probe passed around box, 3 three minute tests.
no results.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0900 Date 12/22/71 Weather _____

Sensor # 1023 Bottle # 1112 act. 12/20

Sensor Test ok Sensor condition ok

Stabilization time 7 min.

Test Material 4 oz. 40% Dupont Gel Dynamite (granular)

Control test ok

Type of Containor exposed on petri dish

Location of Explosive in Containor _____

Listance (probe to test material) 1"

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS,

In all 8 test there was a response within 5 sec.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1700 Date 12/28/1971 Weather _____

Sensor # 1923 Bottle # 1412 oct. 12/20

Sensor Test ok Sensor condition ok

Stabilization time 4-6 min.

Test Material 1 gm. 40% Dupont Gel Dynamite (granular)

Control test ok

Type of Containor exposed on petri dish

Location of Explosive in Containor _____

Listance (probe to test material) 6"

Sampling Time

Test # 1	1 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 one minute tests were conducted, again there were some responses but not enough to trigger the signal.

TEST OFFICER

Glenson

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs Date 12/27/71 Weather _____

Sensor # 1923 Bottle # 1112 act. 12/20

Sensor Test ok Sensor condition ok act.

Stabilization time 5 min.

Test Material 4 oz. 40% Dupont Gel Dynamite(granular)

Control test ok

Type of Containor exposed on petri dish

Location of Explosive in Containor _____

Listance(probe to test material) 12"

Sampling Time

Test # 1	1 min.	5	do
2	do	6	do
3	do	7	do
4	do	8	do

Response: Test# _____ Time _____

REMARKS,

8 one minute tests were conducted, some meter movement but no signal.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1400 hrs Date 12/23/71 Weather _____

Sensor # 1923 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 7 min.

Test Material 2 sticks(1lb) 60% Dupont Gel Dynamite(granular)

Control test ok

Type of Containor shoe box wrapped in brown paper

Location of Explosive in Containor _____

Listance(probe to test material) contact

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 tests were conducted with the probe being inserted into the folds of the package.
Test #1. a negative signal was received in 10 seconds.
Test # 2 thru 8 the signals were erratic with the meter registering mostly on the positive side.
At this time the dynamite had been in the shoebox for 152 hours.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1400 hrs. Date 12/21.71 Weather _____

Sensor # 1923 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 2 sticks(1lb)40% Dupont Gel Dynamite (granular)

Control test ok

Type of Containor shoebox, wrapped in brown paper

Location of Explosive in Containor _____

Listance(probe to test material) 2"

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

At this time the explosives had been contained in the shoe box for a period of 104 hrs.

8 three minute tests were conducted with the probe 2" from the box.

No results.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs Date 12/20/71 Weather _____

Sensor # 1923 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 2 sticks (1 lb) 40 % Dupont Gel Dynamite(granular)

Control test ok

Type of Containor shoebox, wrapped in brown paper

Location of Explosive in Containor _____

Listance(probe to test material) 4"

Sampling Time

Test # 1	3 min.	5	"
2	"	6	"
3	"	7	"
4	"	8	"

Response: Test# _____ Time _____

REMARKS,

At this time the explosives had been contained in the box for a period of 74 hrs.
8 three minute tests were conducted with no results.

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0800 hrs Date 12/17/71 Weather _____

Sensor # 1233 Bottle # 1112

Sensor Test ok Sensor condition ok

Stabilization time 4 min.

Test Material 2 sticks (1 lb) 40% Dupont Gel Dynamite (granular)

Control test ok

Type of Container shoebox wrapped in brown paper

Location of Explosive in Container _____

Listance (probe to test material) 4"

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 three minute tests were conducted with the probe 4" from the box. No Results

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1100 hrs. Date 12/16/71 Weather _____

Sensor # 1923 Bottle # 1112

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 2 sticks, (1 lb) 40% Dupont Gel Dynamite (granular)

Control test ok

Type of Containor shoebox, wrapped in brown paper

Location of Explosive in Containor _____

Listance (probe to test material) 4".

Sampling Time

Test # 1	3min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 three minute tests were conducted with the probe 4 inches from the box. NO RESULTS

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1100 hrs. Date 12/16/71 Weather _____

Sensor # 1923 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 2 sticks, (1 lb) 40% Dupont Gel Dynamite (granular)

Control test ok

Type of Containor shoebox, wrapped in brown paper

Location of Explosive in Containor _____

Listance (probe to test material) 4"

Sampling Time

Test # 1	3min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 three minute tests were conducted with the probe 4 inches from the box. NO RESULTS

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs. Date 12/15/71 Weather _____

Sensor # 1923 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4 to 6 min.

Test Material 2 sticks(1 lb) 40% Dupont Gel Dynamite

Control test ok

Type of Containor Cardboard containor (shoebox)wrapped in brown paper

Location of Explosive in Containor _____

Listance(probe to test material) 4" from box

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 three minute tests were conducted with the probe in a stationary position 4" from the box.

No Results

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Police Academy Garage

Time 0900 Date 12/13/71 Weather _____

Sensor # 1923 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 6 min.

Test Material 8 sticks, 40% Dupont Gel Dynamite(4 lbs) Granular

Control test ok

Type of Container Granular Dynamite in open cardboard carton in car trunk

Location of Explosive in Containor 12 to 14" fro end of trunk

Listance(probe to test material) 12 to 14"

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Dynamite was placed in auto trunk at 1100 hrs on 12/12, a period of 10 hrs prior to test.

8 three minute tests were conducted with the probe held stationary at the lock and seam. No results

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Police Academy Garage

Time 1600 hrs Date 12/12/71 Weather _____

Sensor # 1223 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4-6 min.

Test Material 8 sticks, (4 lbs) Dupont 40% gel dynamib (granular)

Control test ok

Type of Containor explosive placed in paper bag and put in car trunk

Location of Explosive in Containor 12 to 14" from end of trunk

Listance (probe to test material) 12 to 14"

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 three minute tests were conducted, tests were made with the probe being moved about the lock and also held stationary for the test period. No Results

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Police Academy Garage

Time 1100 hrs Date 12/11/71 Weather _____

Sensor # 1922 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4-6 min.

Test Material 8 sticks, 40% Dupont Gel Dynamite (4 lbs)

Control test ok

Type of Containor 8 sticks taped together placed in auto trunk

Location of Explosive in Containor 12 to 14" from end of trunk

Listance (probe to test material) 12 to 14"

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

8 three min. test were conducted/no results
test were made with the probe being moved around the lock and seam of the trunk.

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test

Time 1000 hrs. Date 11/9/71 Weather _____

Sensor # 1739 Bottle # 1113

Sensor Test ok Sensor condition ok

Stabilization time 7 min.

Test Material 40% Dupont Dynamite

Control test ok

Type of Containor empty attache case

Location of Explosive in Containor _____

Listance (probe to test material) ~~inserted thru~~ slightly open case

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

The attachecase tested had contained 4 sticks of 40% Dupont Gel at the time of the test the dynamite was removed.
8 test were conducted and a response was received in all test within 15 sec.

TEST OFFICER

~~Gleason~~

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1400 hrs. Date 11/6/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4-6 min

Test Material 8 oz 40 % Dupont Gel Dynamite

Control test ok

Type of Containor ~~explosive contained in paper bag and placed in~~

Location of Explosive in Containor a desk drawer

Listance (probe to test material) 10/12" outside drawer

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

This was a repeat test, At this point the explosives had been in the desk drawer for a total of 28 hrs. again 8 tests each of 3 min. duration were conducted with no results.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs. Date 11/5/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 8 oz. 40 % Dupont Gem Dynamite (granular)

Control test ok

Type of Container Desk drawer/explosive in paper bag

Location of Explosive in Container _____

Listance (probe to test material) 10/12" (outside drawer)

Sampling Time

Test # 1	3 min.	5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

The paper bag containing the explosive was placed in the desk drawer 4 hours prior to test.
8 test each of 3 min. duration produced no results.

TEST OFFICER

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1500 hrs Date 11/3/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 8 oz dupont 40% gel dynamite (granular)

Control test ok

Type of Containor Gal pipe 2" x 12" capped on both ends.

Location of Explosive in Containor _____

Listance (probe to test material) inserted into pipe

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS,

Response time was within 2-3 seconds in all 8 tests.

TEST OFFICER

Gleason

EXPLOSIVE DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1200 hrs Date 11/3/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4 min.

Test Material 8 oz 40 % dupont Gel granular

Control test ok

Type of Containor gal pipe 2" x 12" capped on both ends

Location of Explosive in Containor in pipe

Listance (probe to test material) at 3/16 opening in end cap

Sampling Time

Test # 1	15 sec.	5	
2		6	
3		7	
4		8	

Response: Test# 1 to 8 Time 15 sec.

REMARKS,

Identification signal received ✓ between 10 to 15 sec.

8 tests

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0900 hrs Date 11/3/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 to 6 min.

Test Material 8 oz 10 % Dupont Gel (wrapped stick)

Control test ok

Type of Containor Galvanized pipe, 2" x 12" capped on both ends.

Location of Explosive in Containor inside pipe

Listance (probe to test material) outside pipe (2" away)

Sampling Time

Test # 1	2 min.	5	
2	"	6	"
3	"	7	"
4	"	8	"

Response: Test# _____ Time _____

REMARKS,

Probe was passed around pipe threads and within 2" of a 3/16" hole which was drilled in one cap.
No results

TEST OFFICER

Gleason

EXPLOSIVE DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1300 hrs. Date 11/1/71 Weather _____

Sensor # 1339 Bottle # 1112

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material ½ oz. Gel. dynamite (granular)

Control test ok

Type of Container Erlenmeyer Flasks

Location of Explosive in Container _____

Distance (probe to test material) at opening

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

Concealment test repeated, results identical

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs. Date 11/1/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 4 oz. granular 40% Dynamite placed in open Erlenmeyer flask.

Control test ok

Type of Container 4 flasks, 1 containing explosive

Location of Explosive in Container _____

Listance (probe to test material) at opening

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

8 concealment tests were conducted, in all tests the flask containing the dynamite was identified within 5 seconds.

Response time for subject flask

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 0900 Date 10/27/71 Weather _____

Sensor # 1739 Bottle # 1A12

Sensor Test ok Sensor condition ok

Stabilization time 6 min.

Test Material 8 oz. 40% Gel. granular in paper bag.

Control test ok

Type of Containor ~~6~~ bag containing explosives placed in attache case.

Location of Explosive in Containor _____

Listance (probe to test material) inserted into slightly open case

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Explosives placed in case 12 hours before test.
Identification made in 8 tests within 5 seconds.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1700 hrs. Date 10/26/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 min.

Test Material 8 oz. granular 40 % gel. in paper bag

Control test OK

Type of Container paper bag containing explosive placed in

Location of Explosive in Containor attache case

Listance (probe to test material) probe inserted into slightly open case

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# _____ Time _____

REMARKS,

Identification signal received within 5 sec. for test # 1-2-3, test 4 to 8 the signal was erratic

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs. Date 10/25/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 6 min.

Test Material 8 oz. Dupont 40% Gel (granular in kraft paper bag)

Control test OK

Type of Container Paper bag inside attache case

Location of Explosive in Container _____

Listance (probe to test material) outside of closed case

Sampling Time

Test # 1	2 min.	5	"
2	"	6	"
3	"	7	"
4	"	8	"

Response: Test# _____ Time _____

REMARKS,

No response in any of 8 tests

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1000 hrs. Date 10-24-71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 5 sec.

Test Material 8 Oz. Dupont 40% Geletin Dynamite

Control test OK

Type of Containor Dynamite was crushed to a granular form and placed in saucer.

Location of Explosive in Containor _____

Listance (probe to test material) .4" above dish

Sampling Time

Test # 1	_____	5	_____
2	_____	6	_____
3	_____	7	_____
4	_____	8	_____

Response: Test# yes Time _____

REMARKS, Signal recorded in all eight tests, respone time in all tests under 5 seconds.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test Bomb Section Office

Time 1640 hrs. Date 10/21/71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test OK Sensor condition OK

Stabilization time 4 to 5 min.

Test Material Hercules Bullseye Pistol Powder 11 oz.

Control test OK (test made at contact)

Type of Containor Powder can (open)

Location of Explosive in Containor container full

Listance (probe to test material) at opening

Sampling Time

Test #	1	5	
	2	6	
	3	7	
	4	8	

Response: Test# _____ Time _____

REMARKS, Identification made, response time in all 8 test in under 5 seconds.

TEST OFFICER

Gleason

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test B.S.

Time 0900 Date 10-20-71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4-5- min

Test Material Hercules Bullseye Pistol Powder 11 oz.

Control test ok

Type of Container open can

Location of Explosive in Containor container full

Listance(probe to test material) opening in can

Sampling Time

Test # 1		5	
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

A positive ID was made in all 8 test in 1-2 seconds.

TEST OFFICER _____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test B.S.

Time 0945 Date 10-18-71 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test ok Sensor condition ok

Stabilization time 4-5 min.

Test Material 40 % Dupont Dyn. K Dk

Control test same mat./ok

Type of Container exposed

Location of Explosive in Containor _____

Listance (probe to test material) 4"

Sampling Time

Test # 1	10 min.	5	Do
2		6	
3		7	
4		8	

Response: Test# _____ Time _____

REMARKS,

Erratic signals

TEST OFFICER

_____

EXPLOSIVES DETECTOR EVALUATION TESTS

Location of Test B.S.

Time 1000 Date Oct. 17, 1971 Weather _____

Sensor # 1739 Bottle # 1412

Sensor Test OK Sensor condition OK

Stabilization time 4 min.

Test Material 8 oz. Dupont 40% Gel Dynamite

Control test same

Type of Container exposed

Location of Explosive in Containor _____

Listance (probe to test material) 12"

Sampling Time

Test #	1	5 min	5	do
	2	"	6	do
	3	"	7	do
	4	"	8	do

Response: Test # none Time _____

REMARKS,

This test was repeated 4 times with out obtaining a reading. The same test using 8 and 4" distances was tried and again without results.

TEST OFFICER

_____

APPENDIX C

Breadboard Detection System Manual

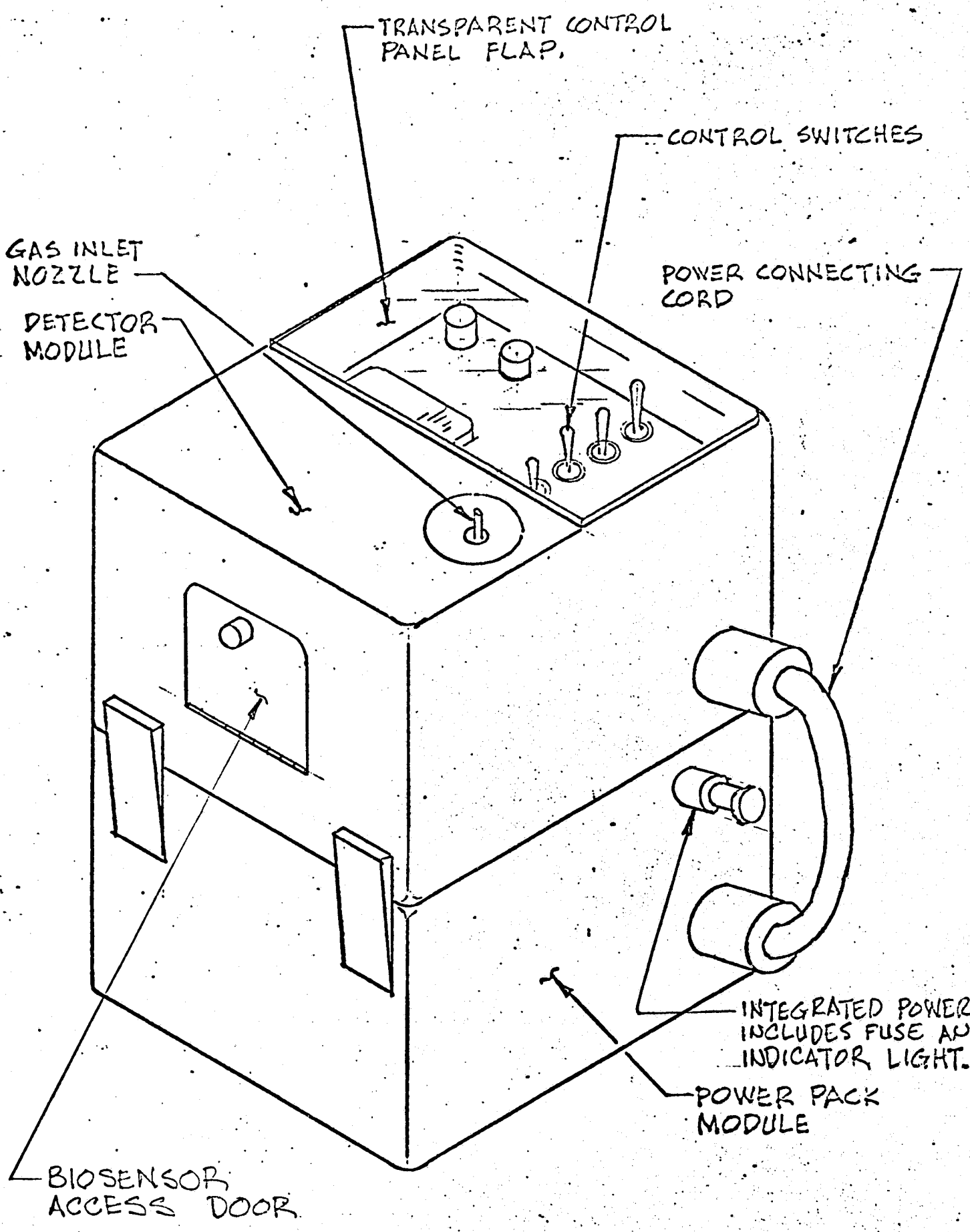
MANUAL

Model 3232-A

BREADBOARD DETECTION SYSTEM

1971

TABLE OF CONTENTS



DETECTOR CONFIGURATION PICTORIAL

I. PRINCIPLE OF OPERATION

The RPC Model 3232-A Vapor Detection System makes use of the fact that certain bacteria are luminescent and that the intensity of the luminescence varies due to exposure to certain vapors. Using a photocell and a differentiating circuit to give an output signal proportional to the rate-of-change of intensity, alarm signals can be generated. The RPC bacterial strains are grown in a biosensor cartridge. The cartridge is inserted into a sensor chamber, through which a continuous flow of sample air is drawn. Output signals are detectable in four separate forms:

A. Meter reading

B. Remote recorder (not provided)

C. Alarm light

D. Alarm horn

II. CONSTRUCTION

The detection system consists of four major subassemblies (boxes):

A. Detector

B. AC Power Supply

C. DC Power Supply

D. Battery Charge Controller

The Detector may be operated remotely from a power supply by using a ten foot cable supplied with the system. If portable operation is desired, the units may be fastened together as an integral unit and carried by means of the shoulder harness provided for that purpose. A one foot cable is used to connect the two units for this configuration.

A. Detector

The Detector houses all components necessary for system operation except the power source. Internal construction of the box is arranged to house most of the electronic circuitry in one half (beneath the panel), and the detector chamber, air sample pump, alarm horn in the other half. The panel is arranged for convenient operation and meter and alarm light visibility. A multi-position meter switch allows not only selection of biosensor signals but also a check of power supply voltages. Other switches for system operation are located in the lower portion of the panel.

Biosensor cartridge replacement is made through an access door in the end of the unit. The air sample tube is attached to the ½ inch

tube stub in the top center area of the Detector.

B. AC Power Supply

The AC Power Supply is built for 115 VAC, 60 Hertz power and contains all the necessary transformers and electronics to provide the various voltages and currents necessary for Detector operation. Power for Detector operation is turned on by a switch on this box. When not in use with the Detector, the AC Power Supply may be used in conjunction with the Battery Charge Controller to recharge the batteries in the DC Power Supply.

C. DC Power Supply

This unit is interchangeable as a power supply with the AC unit and is used for portable operation. The batteries are fused internally, and no power switch is supplied with the unit.

D. Battery Charge Controller

This unit contains the electronic components and circuitry with which to charge the batteries in the DC Power Supply. The controller derives its power from the AC Power Supply.

III. DESCRIPTION

A. Sampling System

The air sample is drawn through the unit by a diaphragm-type pump which is operated from a 6 VDC regulated power supply and controlled by the PUMP ON switch on the Detector panel. The flow is factory-adjusted to an optimum rate of 1 liter/minute. The sample flow is directed by the sample tubing into the exposure chamber where it passes across the surface of the luminescent bacteria. If the vapor-of-interest is present the bacteria respond by changing their luminescent level. A photocell, mounted opposite the biosensor, produces an electrical signal proportional to the light intensity which is then amplified and conditioned to provide the various output forms.

B. Electronic Circuitry

The light emitted by the biosensor is extremely dim (somewhat comparable to that reaching the earth from a star) and, therefore, must be amplified many times to give a usable signal. A plug-in type printed circuit board in the Detector contains complete solid state components and circuitry. The circuit not only provides high amplication, but also determines its rate-of-change, and whether its direction is positive or negative in order to actuate the proper alarm for the vapor of interest.

Another printed circuit board is contained in the Detector to provide temperature control of the detector chamber to within 68 to 70°F.

IV. OPERATING INSTRUCTIONS

CAUTION: DO NOT REMOVE BIOSENSOR CARTRIDGE WHEN POWER IS ON

A. Initial Set-Up

1. Connect the Detector to either the AC or DC power supply by means of the 1-foot or 10-foot electrical cable supplied with the system. Make sure that the connectors on the cable ends are completely engaged into the sockets on the boxes. Only a few screw threads should be visible on the correctly-mated connector.

If the AC Power Supply has been connected to the Detector, assure that the push-pull power switch is OFF by pulling the end portion of the switch outward away from the box. Plug the AC cord of the power supply into a receptacle which provides normal 115 volt, 60 Hertz power.

2. Assure that the SENSE switch on the Detector control panel is OFF, then open cartridge access door, remove the cartridge cover and insert a biosensor cartridge into the detector chamber with the open end towards the chamber. Use care that nothing touches the open end during insertion. Replace the cover finger-tight, replace the piece of soft insulation on the cartridge handle, and close the hinged access door.

3. Turn on the SENSE switch and verify that power is on by observing a meter reading to be essentially full scale in each direction when the meter selector switch is switched from +15 to -15 positions.

4. Determine ambient air temperature. If it is warmer than 69° turn TEMP switch to COOL. If it is cooler than 69° turn TEMP switch to HEAT. Verify that a whirring sound can be heard from a cooling blower. NOTE - The TEMP switch should always be off when the SENSE switch is off.

5. Turn on the PUMP ON switch and verify that a "buzzing" sound from the pump can be heard.

6. Display the intensity output by turning meter switch to its INT position and adjust GAIN control give an intensity reading of from 20 to 50. NOTE - A higher intensity voltage will produce a correspondingly higher rate sensitivity. If an intensity voltage of 20 to 50 cannot be reached by maximum clockwise rotation of the GAIN control the biosensor is too dim and should be replaced.

7. Turn the switch to RATE, and wait a few minutes until the rate reading on the meter reaches and remains in the range of ± 25, as indicated on the glass face of the meter. Detector is now ready for sample tests.

B. Operation

1. Sampling of vapors will cause a variation of the light intensity of the bacteria. This can best be observed by watching the meter while its switch is in the RATE position.

2. Periodically check the intensity reading and readjust the

gain potentiometer if the reading falls below 20.

3. Shut down of the Detector after use consists of turning off the following switches:

TEMP switch (Detector panel)

PUMP switch (Detector panel)

SENSE switch (Detector panel)

Power switch (AC Power Supply)

V. MAINTENANCE

Except for battery recharge, the system does not require any periodic maintenance.

To Recharge the DC Power Supply

A. Connect the DC Power Supply to the 2-foot cable of the Battery Charge Controller.

B. Connect the AC Power Supply to the Controller using either the 1-foot or 10-foot extension cables.

C. Turn on switch of the AC Power Supply.

D. Depress each of the two switches on the panel of the Battery Charge Controller. Note that each of the two indicator lights near the switches illuminate.

E. Charger will automatically shut off when batteries are charged. Both lights must be out before DC Power Supply is fully charged.

NOTE: The lead-acid batteries of the DC Power Supply have a slight decay to their charge if stored or unused for long periods. It is recommended that if the DC Power Supply remains unused for a month or longer, it should be recharged in the manner described above. This type of charge should only require approximately 1 to 2 hours, as compared to 12 to 15 hours for a complete recharge.

APPENDIX D

Prototype Detection System Manual

MANUAL

Model 3334-10

and

Model 3334-11

PROTOTYPE DETECTION SYSTEM

1972

TABLE OF CONTENTS

I. PRINCIPLE OF OPERATION

The RPC Model 3334 Vapor Detection System makes use of the fact that certain bacteria are luminescent and that the intensity of the luminescence varies due to exposure to certain vapors. The RPC bacterial strains are grown in a biosensor cartridge. The cartridge is inserted into a sensor chamber through which a continuous flow of sample air is drawn. Using a photocell and an electronic circuit to give an output signal proportional to the rate-of-change of intensity, various output signals are generated when a specific vapor is present in the sample air. Output signals are presented in three separate forms in the Model 3334:

A. Recorder output (recorder is not provided)

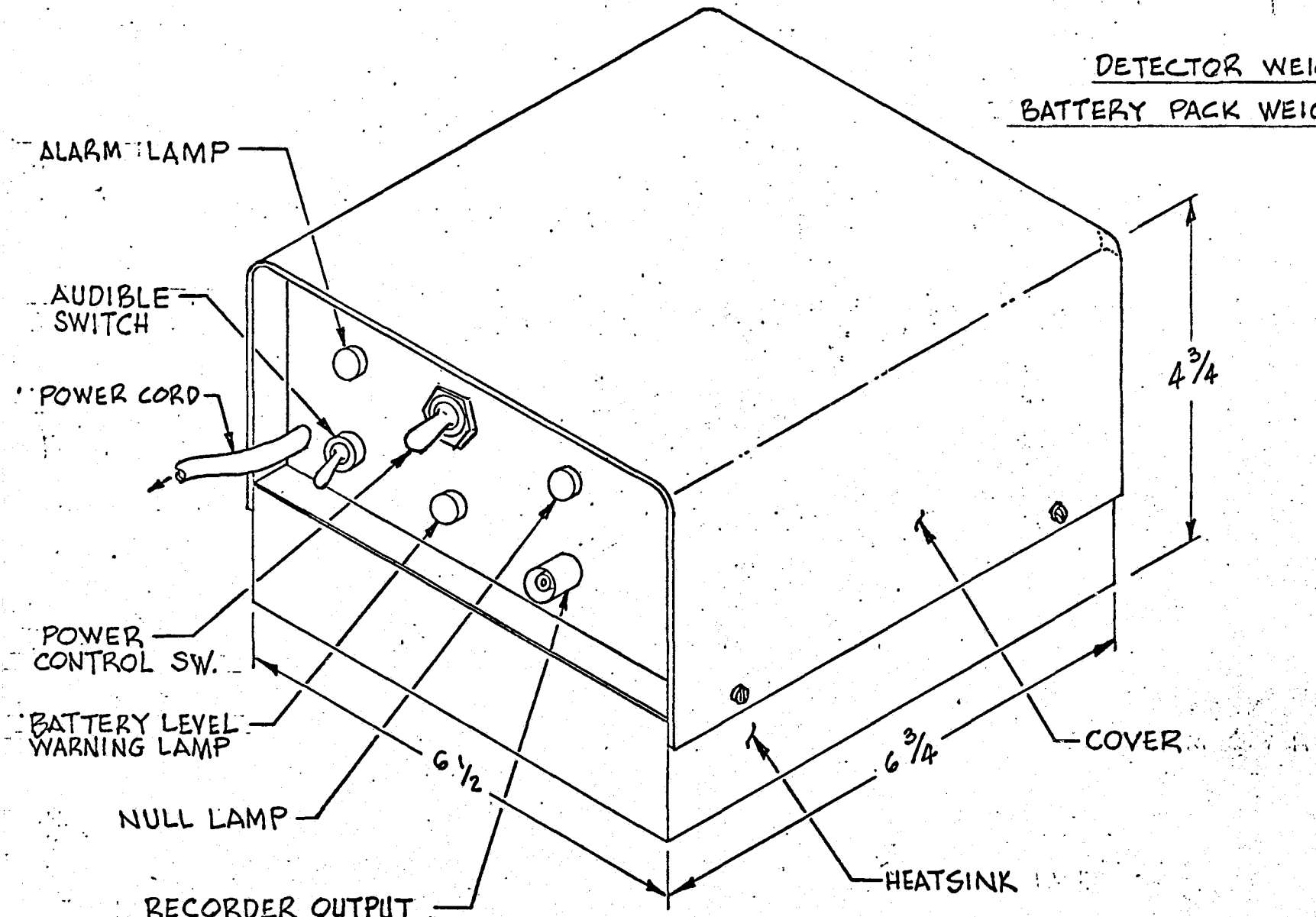
B. Alarm lamp

C. Alarm buzzer

The Model 3334 contains an environmental control system to maintain the biosensor cartridge at its optimum temperature and a humidifier to precondition the sample air.

DETECTOR WEIGHT - 5 LBS

BATTERY PACK WEIGHT - 3 LBS



NYPD PROTOTYPE DETECTOR (ENVIRONMENTALLY CONTROLLED)

11-23-71

II. DESCRIPTION

The detection system consists of four major units:

A. Detector

B. AC Power Supply

C. DC Power Supply

D. Battery Charge Controller

The Detector may be operated from either power supply. The AC Power Supply and the Battery Charge Controller are used to recharge the batteries in the DC Power Supply. The necessary interconnecting cables are also supplied.

A. Detector

The Detector houses all of the components necessary for system operation except the power source. The Detector is designed as a hand-held device and is connected to the DC Power Supply through an integral 3-foot cable or to the AC Power Supply through an integral 3-foot cable plus a 6-foot adapter cable.

Two switches for system operation are located on the detector panel. The panel contains the following:

Power Control Switch (OPERATE-OFF-STBY)

Audible Alarm Switch (AUDIO OFF-ON)

Recorder Output Connector (RCDR)

Battery Level Warning Lamp (CHG BATT)

Null Lamp (NULL)

Alarm Lamp (ALARM)

Biosensor cartridge replacement is made through an opening in the base of the unit. The sample inlet and the humidifier fill tube protrude from the side of the unit. A handle is provided for carrying the Detector. The base of the unit provides the heat dissipating surface required for the environmental control system.

The air sample is drawn through the unit by a vane-type pump which is operated from regulated DC power and controlled by the STANDBY-OPERATE switch on the Detector panel. The flow is factory-adjusted to an optimum rate. The sample flow is directed through a humidifier and into the exposure chamber where it impinges on the active surface of the biosensor cartridge. If the vapor-of-interest is present, the bacteria respond by changing their luminescent level. The resistance of the photocell, mounted opposite the biosensor, is proportional to the light intensity and the varying resistance is processed to provide the various output forms.

The light emitted by the biosensor is extremely dim (somewhat comparable to that reaching the earth from a star). A printed circuit board in the Detector contains solid state circuitry to provide a voltage proportional to the change of the light intensity. A trigger circuit is provided to actuate the alarm, if the magnitude and direction of the intensity change indicates the presence of the vapor-of-interest.

Another printed circuit board in the Detector contains circuitry to control the temperature of the detector chamber to 69°F ($\pm$ 1°F).

Circuits are included to monitor the battery voltage levels. If a battery is discharged, the CHG BATT lamp will light and remain lighted.

B. AC Power Supply*

The AC Power Supply is built for 115 VAC, 60 Hertz power and, in conjunction with the adapter cable, it contains all the necessary circuitry to provide the various voltages and currents necessary for Detector operation. Power is applied to the power supply by a switch on the box. The AC Power Supply is also used in conjunction with the Battery Charge Controller to recharge the batteries in the DC Power Supply.

C. DC Power Supply

This unit is designed for use during portable operation and can operate the Detector for over four hours. The batteries may be recharged as necessary by using the AC Power Supply and the Battery Charge Controller.

D. Battery Charge Controller

This unit contains the circuitry to charge the batteries in the DC Power Supply. The controller derives its power from the AC Power Supply. The charging cycle is automatically controlled to eliminate any possibility of overcharging of the batteries.

*The AC Power Supply was delivered with the Model 3232-A systems.

III. OPERATING INSTRUCTIONS

A. Initial Preparation

1. Connect either the AC Power Supply (using the adapter cable) or the DC Power Supply to the Detector. If the AC Power Supply is used, plug the power cord into a standard 115V, 60 Hertz outlet and turn on the supply by pushing the switch (the self-contained pilot lamp should light).

2. Place the OPERATE-STBY switch in the STBY position to allow the environmental control system to operate. About five minutes is required to stabilize the temperature of the unit. Assure that the CHG BATT lamp is off before proceeding further. The CHG BATT lamp may flash occasionally, which is not cause for recharging the batteries.

3. Fill the humidifier with distilled water through the fill tube (beside the sample inlet probe). With no biosensor in the chamber, operate the pump for five minutes by placing the OPERATE-STBY switch in OPERATE.

B. Biosensor Insertion

1. Momentarily place the OPERATE-STBY switch in OPERATE to clear any water from the inlet probe.

2. Remove the cartridge cover (in base of the unit) and dry chamber prior to insertion of biosensor. Insert a biosensor cartridge into the detector chamber with the open end towards the chamber. Use care to assure that nothing touches the open end of the cartridge. Replace the

cover finger-tight.

3. Leave the OPERATE-STBY switch in STBY until ready for use (if immediate use is desired, leave the switch in STBY for at least two minutes).

C. Operation

1. Switch the OPERATE-STBY switch to OPERATE and wait until the NULL and ALARM lamps are off. The unit is now ready for operation.

2. Place the sample inlet probe into the area of interest and hold it there for 10-20 seconds to avoid false alarms. Do not block the flow through the probe or unduly move the unit about.

3. If the vapor-of-interest is present, the ALARM lamp will light and the ALARM buzzer will sound (if the Audible Alarm Switch is ON).

4. After the exposure, the alarm will turn off and the NULL lamp may light due to a backswing. Wait until both lamps are off before attempting further detections.

D. Battery Charging

1. If the CHG BATT lamp lights continuously, the DC Power Supply requires charging. Do not charge the unit unless, the light indicates a low charge condition.

2. Connect the DC Power Supply and the AC Power Supply to the Battery Charge Controller and turn on the AC supply.

3. Press all pushbutton switches on the Battery Charge Controller. All of the indicator lamps should light. When each battery is charged, the respective lamp will turn off. When all lamps are off, the DC Power Supply is fully charged. If a light does not stay on when the button is released and/or a buzzing sound occurs when the button is pushed, the battery is already charged sufficiently.

E. Storage

1. If the system is not to be used for a period of time, place the OPERATE-STBY switch in the OFF position, remove the biosensor cartridge, and disconnect the power supply from the Detector.

IV. MAINTENANCE

Periodic Service

1. Battery Charge - The DC Power Supply should be charged only when necessary. It is recommended that it be charged (see Section III for the procedure) whenever the CHG BATT lamp indicates a low charge condition. Do not allow the batteries to discharge completely (disconnect the supply from the Detector when stored or whenever the CHG BATT lamp lights.)

2. Filling of the Humidifier - The reservoir of the humidifier should be filled prior to usage of the Detector. Use distilled water and fill with a syringe or eyedropper until no further water can be absorbed. Operate the pump (by placing the OPERATE-STBY switch in OPERATE) for about five minutes and make sure chamber is not wetted by excessive water before inserting a biosensor cartridge.

3. Cleaning of the Inlet Probe - After any extended usage, the inlet probe should be cleaned by the following procedure:

a. Remove probe by gently twisting and pulling.

b. Rinse probe with warm water and allow it to dry.

c. Remove the biosensor cartridge cover and force distilled water through the inlet passage from the inlet of the detector to the chamber.

d. Put a pipe cleaner through the inlet passage from the inlet to the chamber. Remove the pipe cleaner and rinse per Step c.

e. Replace cover and probe.

f. Operate the pump (by placing the OPERATE-STBY switch in OPERATE) for about 10 minutes before use.

4. Cleaning of the Pump - The pump may become fouled with particles or fluid after a period of use. The symptoms are a noisy clatter or a high-pitched whine. If this occurs, the pump must be cleaned by following these steps:

a. Remove cover by removing the four screws on the sides and the top screw on the panel.

b. Slide sleeving back and unsolder the photocell leads (emerging from hole in circuit board).

c. Remove screw in rear of circuit board and the two screws in bottom of panel. Unsolder the gray wire from the pump and unplug the receptacle. This disconnects the panel and circuit board from the base of the unit.

d. Loosen the two screws holding the pump to the bracket and remove the four screws that hold the end plate to the pump body. Do not allow vanes to fall from the pump as the end plate is removed.

e. Remove vanes one at a time and clean all surfaces (except edge that is towards the bottom of the rotor slot) with fine emery paper. Replace each vane in its original orientation.

f. Wipe end plate with a clean cloth and allow rotor to dry (if it is wet). Then replace end plate and tighten all six screws (four in end plate and two in bracket).

g. Verify that hose between the pump and the exposure chamber is in place.

h. Reconnect connector, resolder the gray pump wire and replace the circuit board-panel assembly.

i. Resolder photocell leads and slide the sleeving over the joint.

j. Replace cover.

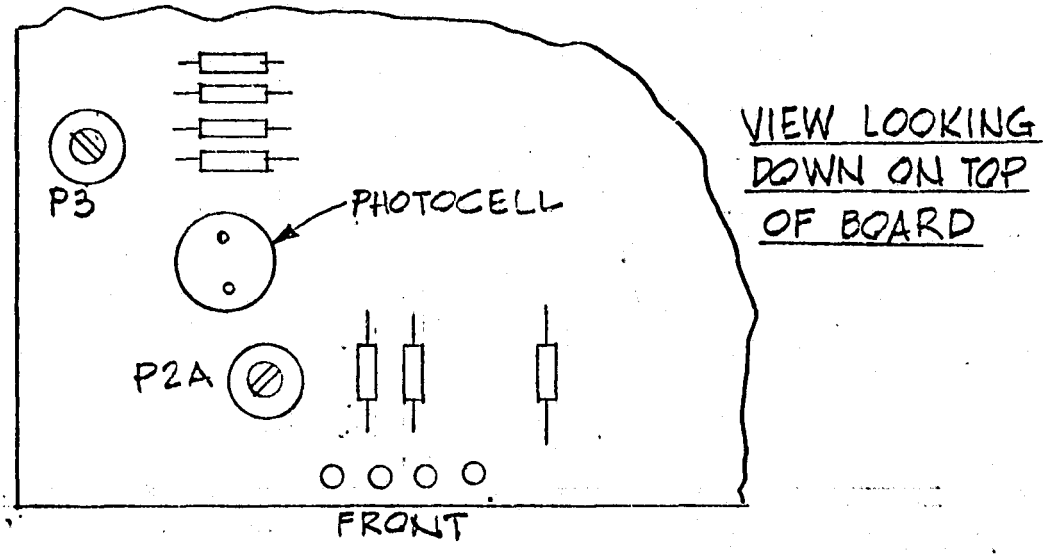
Adjustments

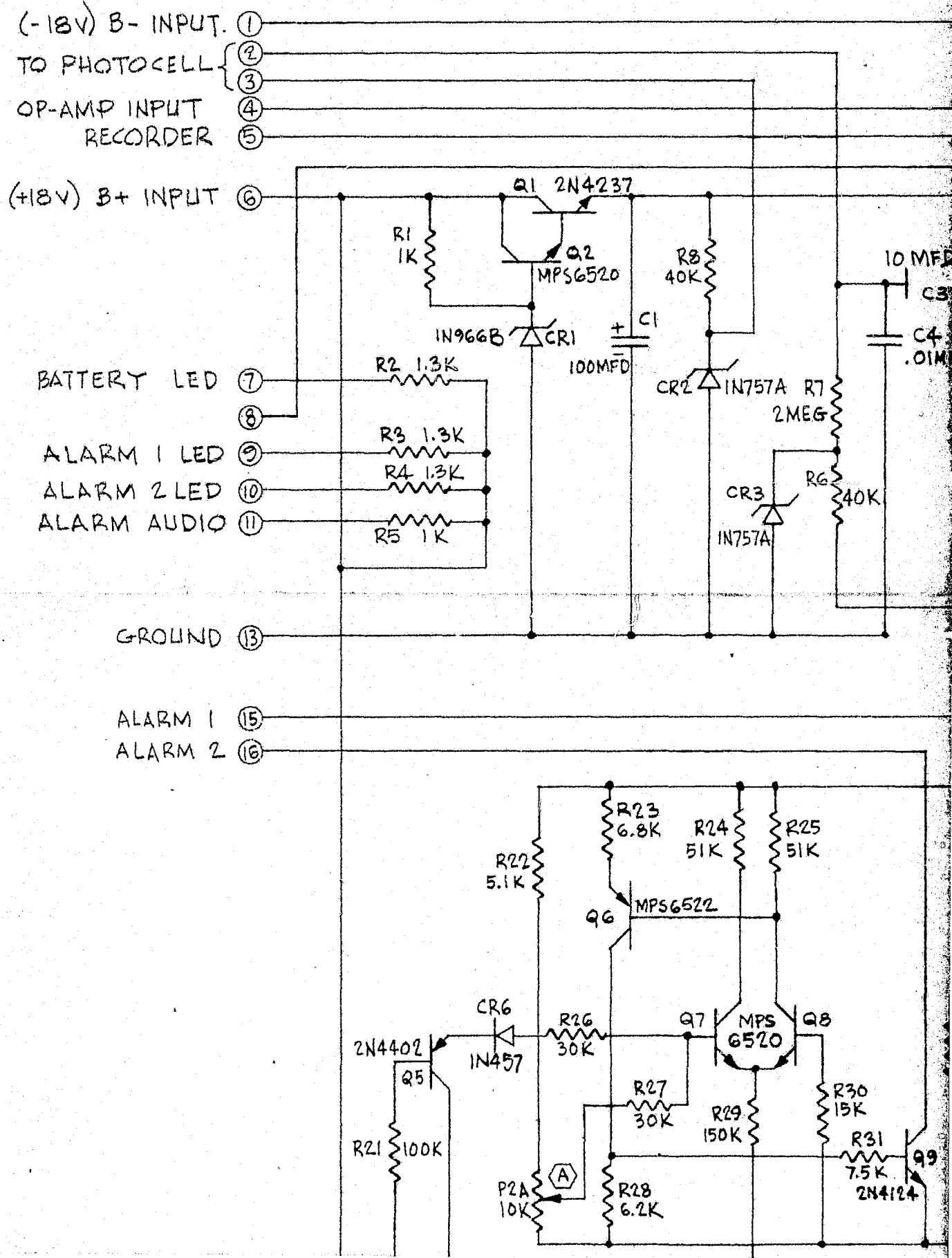
No adjustments are necessary for normal use of the unit. However, the following adjustments may be made for special applications by removing the cover (four screws on cover and one screw on top of panel), and adjusting the potentiometers as follows:

Alarm Level...The signal level required to actuate the alarm can be varied by adjusting potentiometer P2A CCW to move alarm point closer to zero (for dynamite units), or P3 CW to move alarm point closer to zero (for heroin units). See sketch for location of controls.

Null Level...The signal level required to actuate the null lamp can be varied by adjusting potentiometer P3 CW to move null point closer to zero (for dynamite units), or P2A CCW to move null point closer to zero (for heroin units). See sketch for location of controls.

No other potentiometers should be moved from their factory-set positions.




(-18V) B- INPUT. 1
TO PHOTOCELL 2
3
OP-AMP INPUT 4
RECORDER 5
(+18V) B+ INPUT 6
BATTERY LED 7
8
ALARM 1 LED 9
ALARM 2 LED 10
ALARM AUDIO 11
GROUND 13
ALARM 1 15
ALARM 2 16
Q1 2N4237
Q2 MPS6520
R1 1K
R2 1.3K
R3 1.3K
R4 1.3K
R5 1K
R8 40K
IN966B CR1
C1 100MFD
CR2 IN757A
R7 2MEG
R6 40K
CR3 IN757A
10 MFD
C3
C4 .01M
R23 6.8K
R24 51K
R25 51K
R22 5.1K
Q6 MPS6522
CR6 IN457
R26 30K
Q7 MPS 6520
Q8
2N4402 Q5
R27 30K
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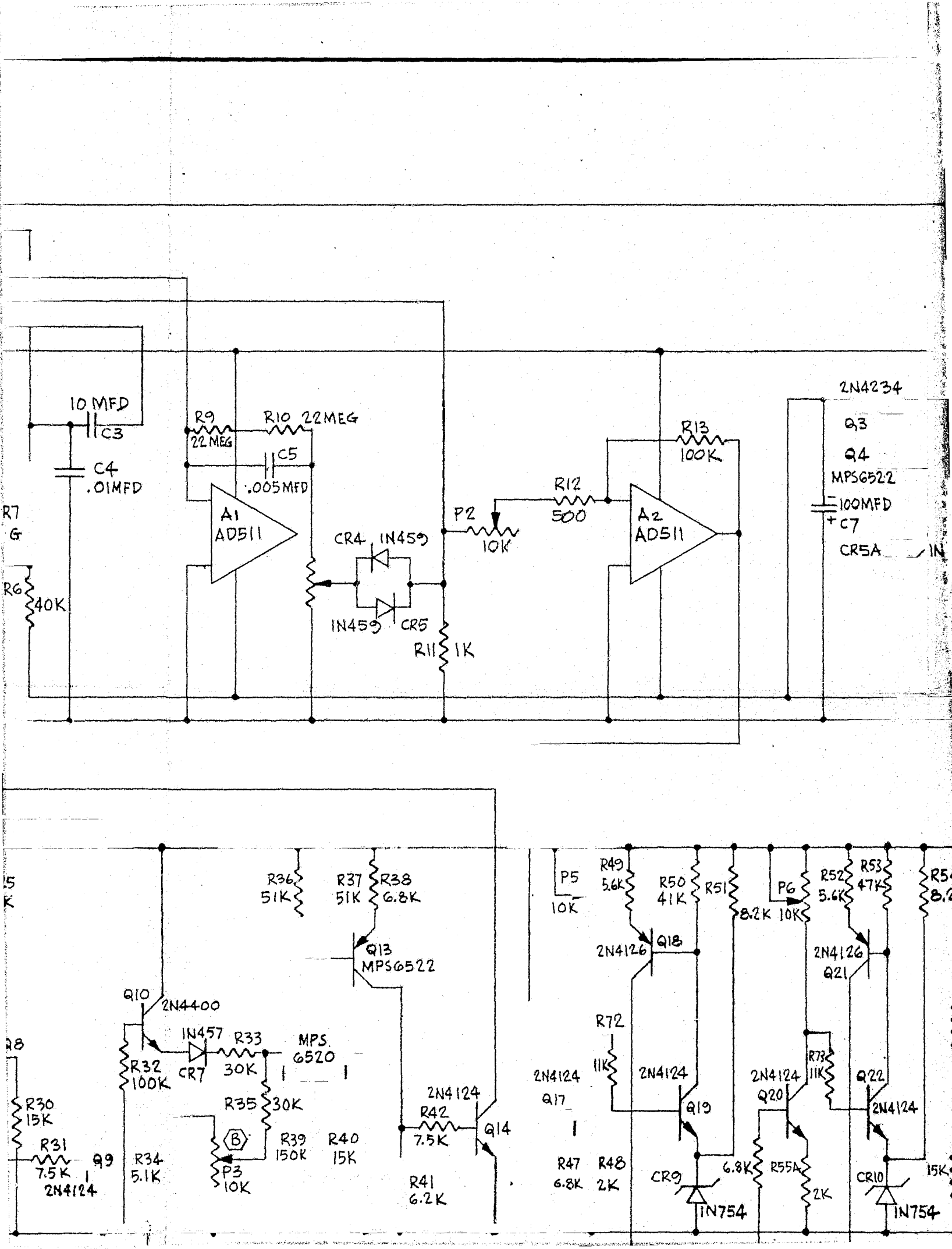
R30 15K
R31 7.5K
Q9 2N4124
R21 100K
P2A 10K
A
R28 6.2K


10 MFD
C3
C4
.01MFD
R9
22 MEG
R10 22MEG
C5
.005MFD
A1
AD511
R7
G
R6
40K
CR4 IN459
IN459 CR5
R11 1K
P2
10K
R12
500
A2
AD511
R13
100K
2N4234
Q3
Q4
MPSG522
100MFD
C7
CR5A
IN
R36
51K
R37
51K
R38
6.8K
Q13
MPSG522
Q10
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IN457
R33
MPS.
6520
R32
100K
CR7
30K
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R31
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R40
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R42
7.5K
Q14
R41
6.2K
P5
10K
R49
5.6K
R50
41K
R51
8.2K
P6
10K
R52
5.6K
R53
47K
2N4126
Q18
2N4126
Q21
R72
11K
2N4124
Q17
2N4124
Q19
R73
11K
2N4124
Q20
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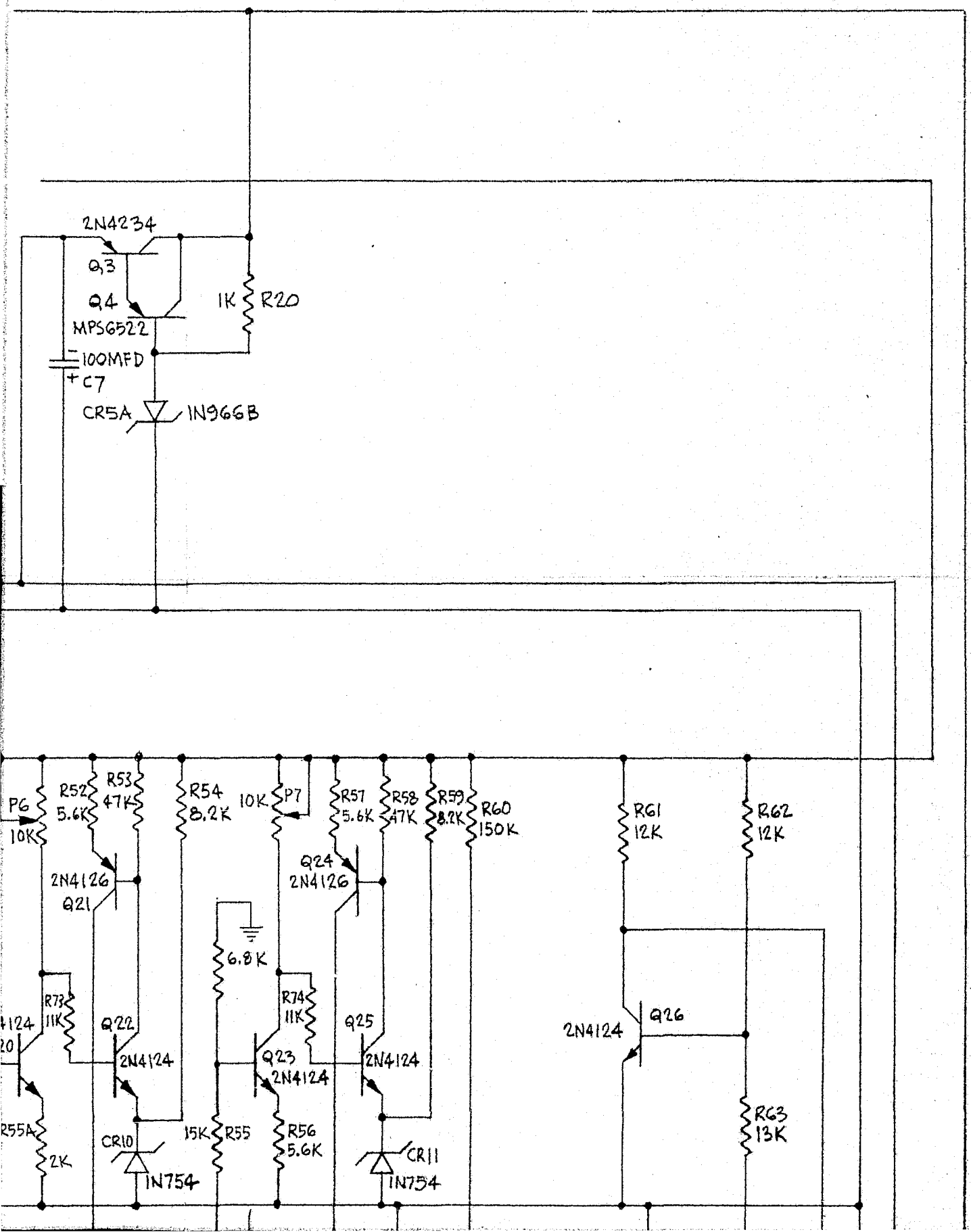
2N4234
Q3
Q4
MPSG522
1K R20
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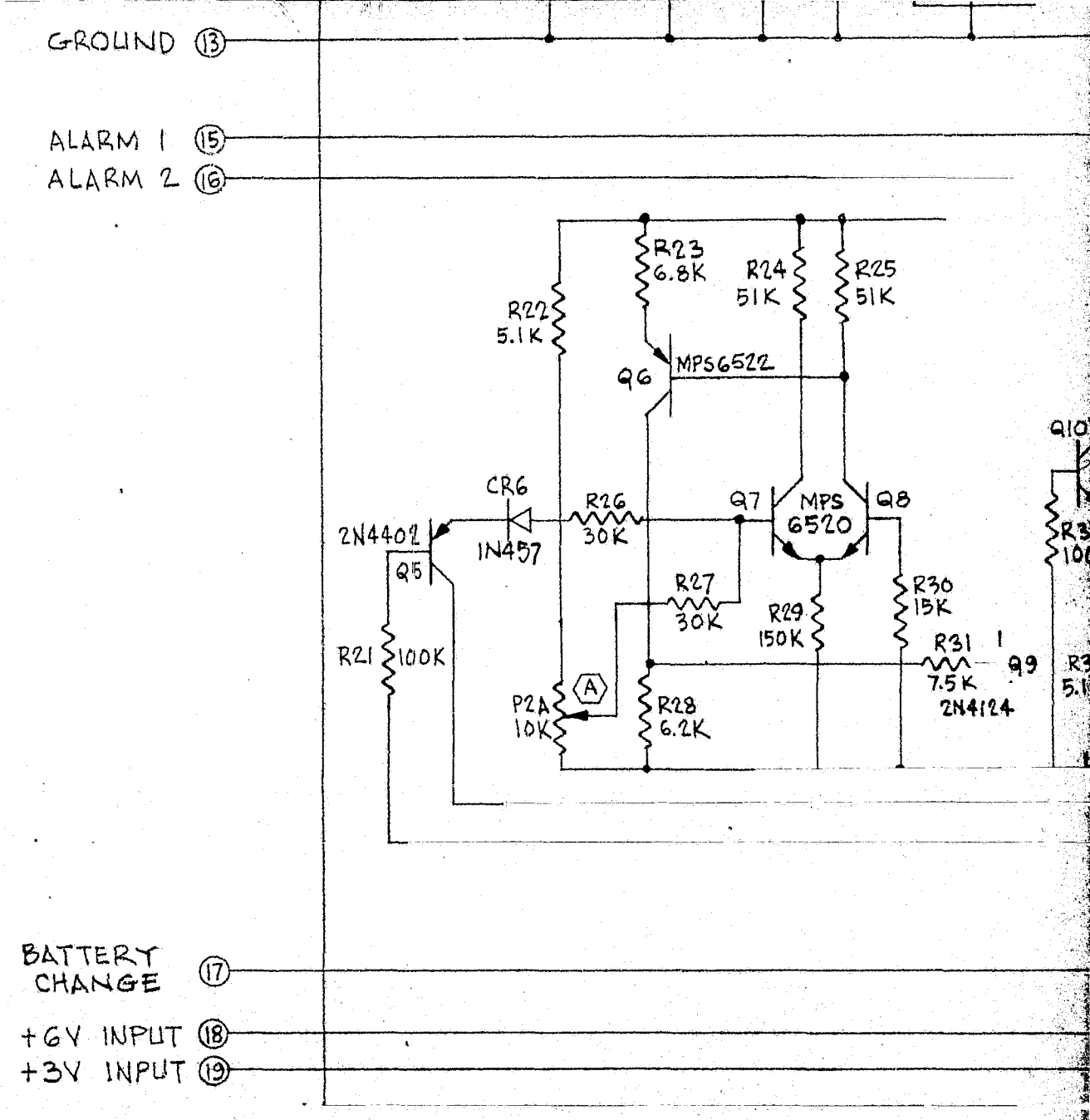
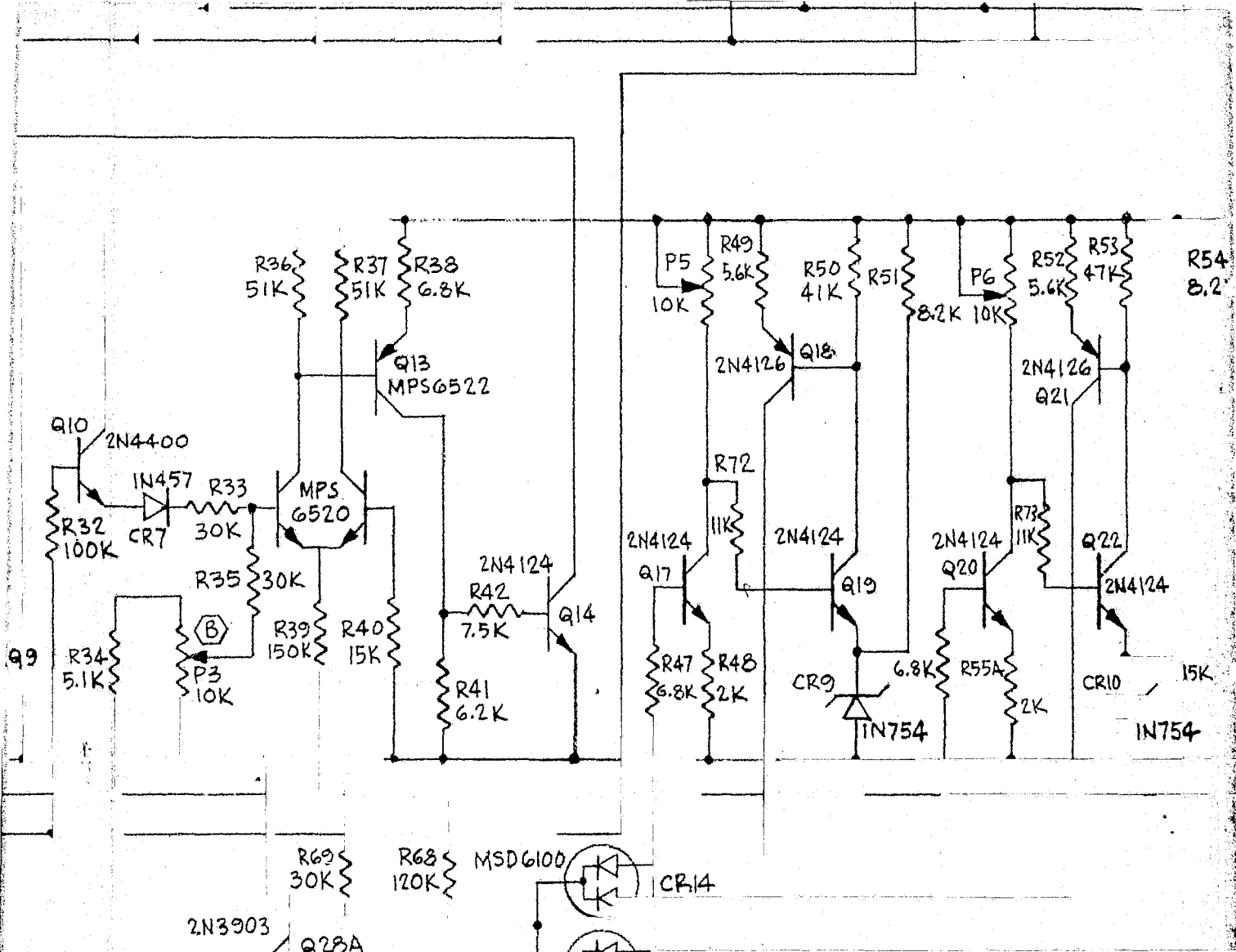
C7
CR5A IN966B
P6
10K
R52 5.6K
R53 47K
R54 8.2K
10K P7
R57 5.6K
R58 47K
R59 8.2K
R60 150K
RG1 12K
RG2 12K
2N4126 Q21
Q24 2N4126
6.8K
R73 11K
Q22
2N4124
R74 11K
Q25
2N4124
Q23 2N4124
Q26
2N4124
R55A 2K
CR10 IN754
15K R55
R56 5.6K
CR11 IN754
RG3 13K



(B) - ADJUST P3 COUNTER CLOCKWISE TO INCREASE

(A) - ADJUST P2A COUNTER CLOCKWISE TO DECREASE

NOTES:



ASE POSITIVE ALARM VOLTAGE.

ASE NEGATIVE ALARM VOLTAGE.

TOLERANCES (UNLESS OTH

LINEAR

ANG _.r

SURF/
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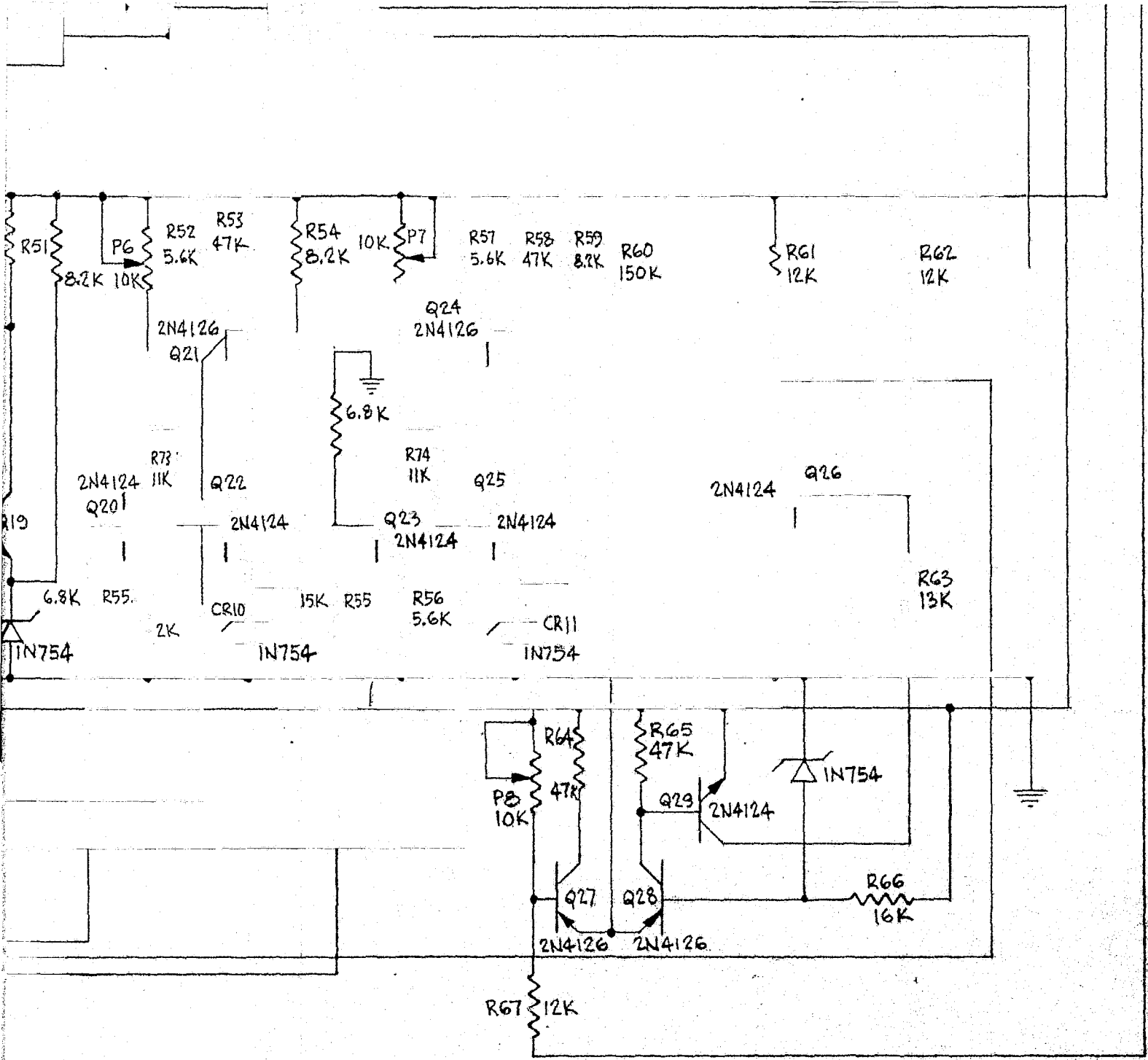


RPC CORPORATION

1222 E. GRAND AVE EL SEGUNDO, CALIF.

ENGINEER:	DATE:	SCALE:	DO NOT SCALE DRAWING
DRAFTSMAN: W.D.M.	DATE: 2-11-72	MATERIAL:	
CHECKED BY:	DATE:	FINISH:	
APPROVED BY:	DATE:		

TITLE: DETECTOR PROTOTYPE-NYPD ELECTRONICS P.C. BOARD

NEXT ASSY.

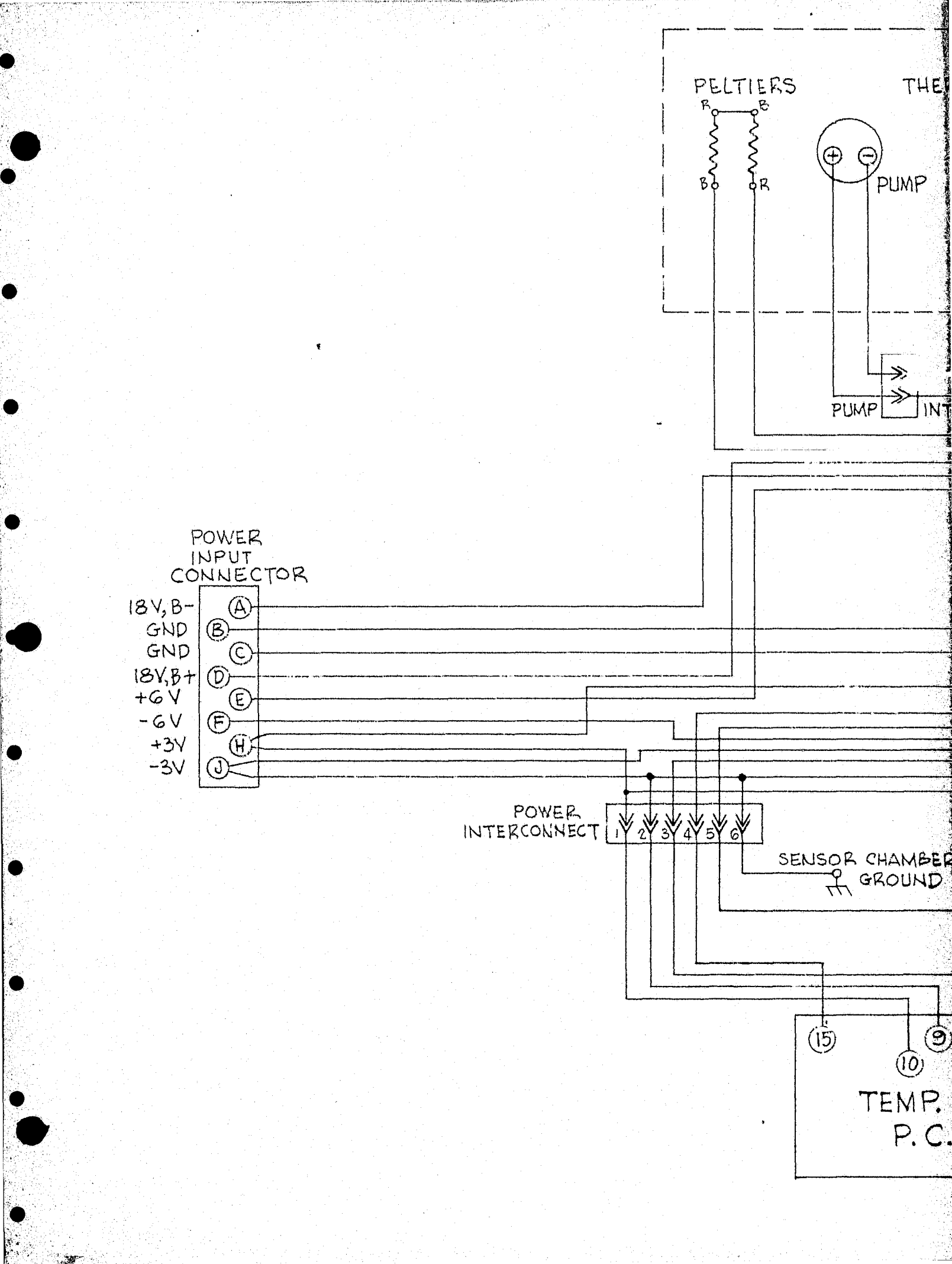
DRAWING NO. 72-006

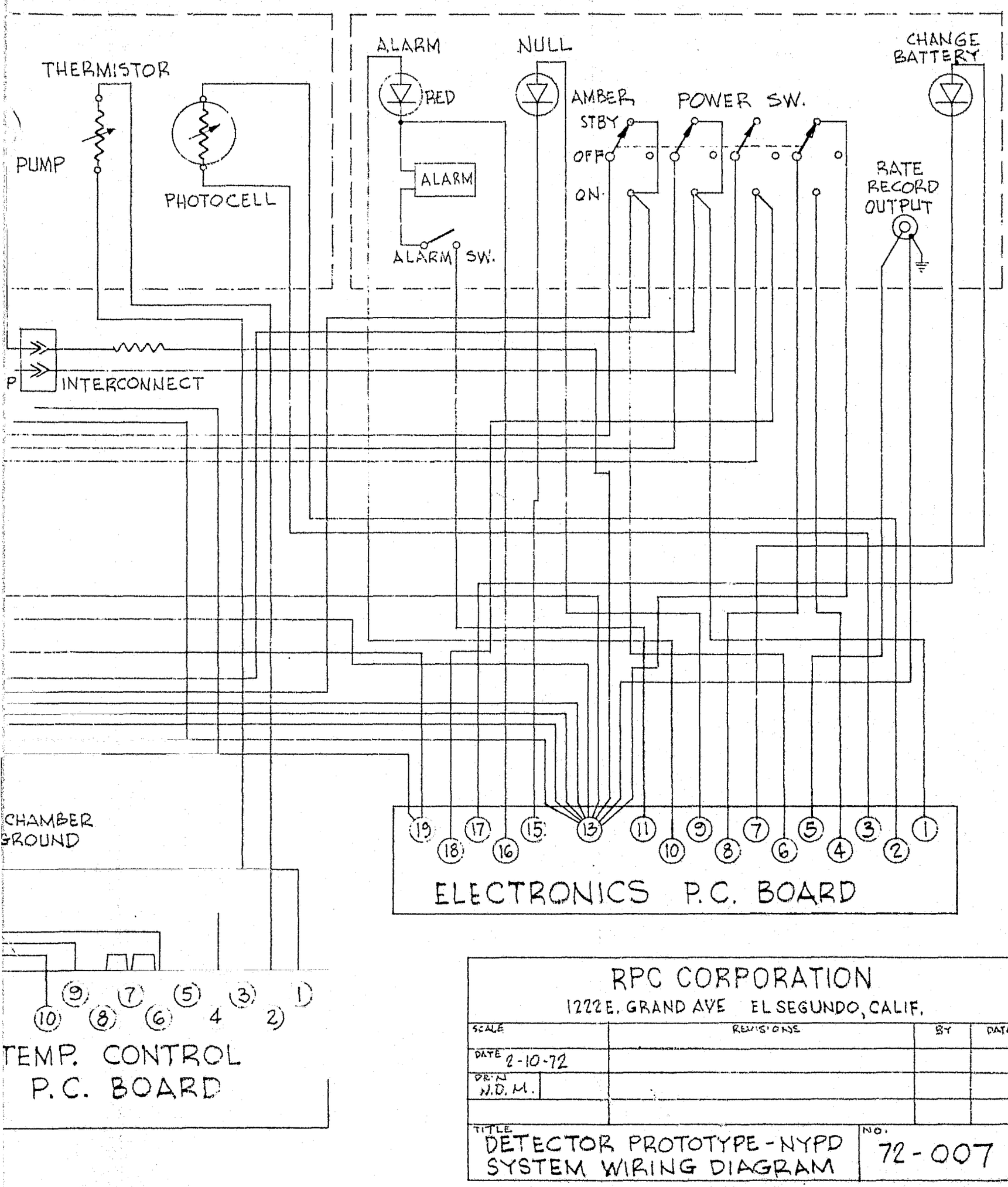
TOLERANCES (UNLESS OTHERWISE SP ..IED)

LINEAR

ANG ..r

SURFACE FINISH


PELTIERS
THE
R
B
B
R
PUMP
PUMP
INT
POWER
INPUT
CONNECTOR
18V, B-
GND
GND
18V, B+
+6V
-6V
+3V
-3V
A
B
C
D
E
F
H
J
POWER
INTERCONNECT
1
2
3
4
5
6
SENSOR CHAMBER
GROUND
15
9
10
TEMP.
P.C.



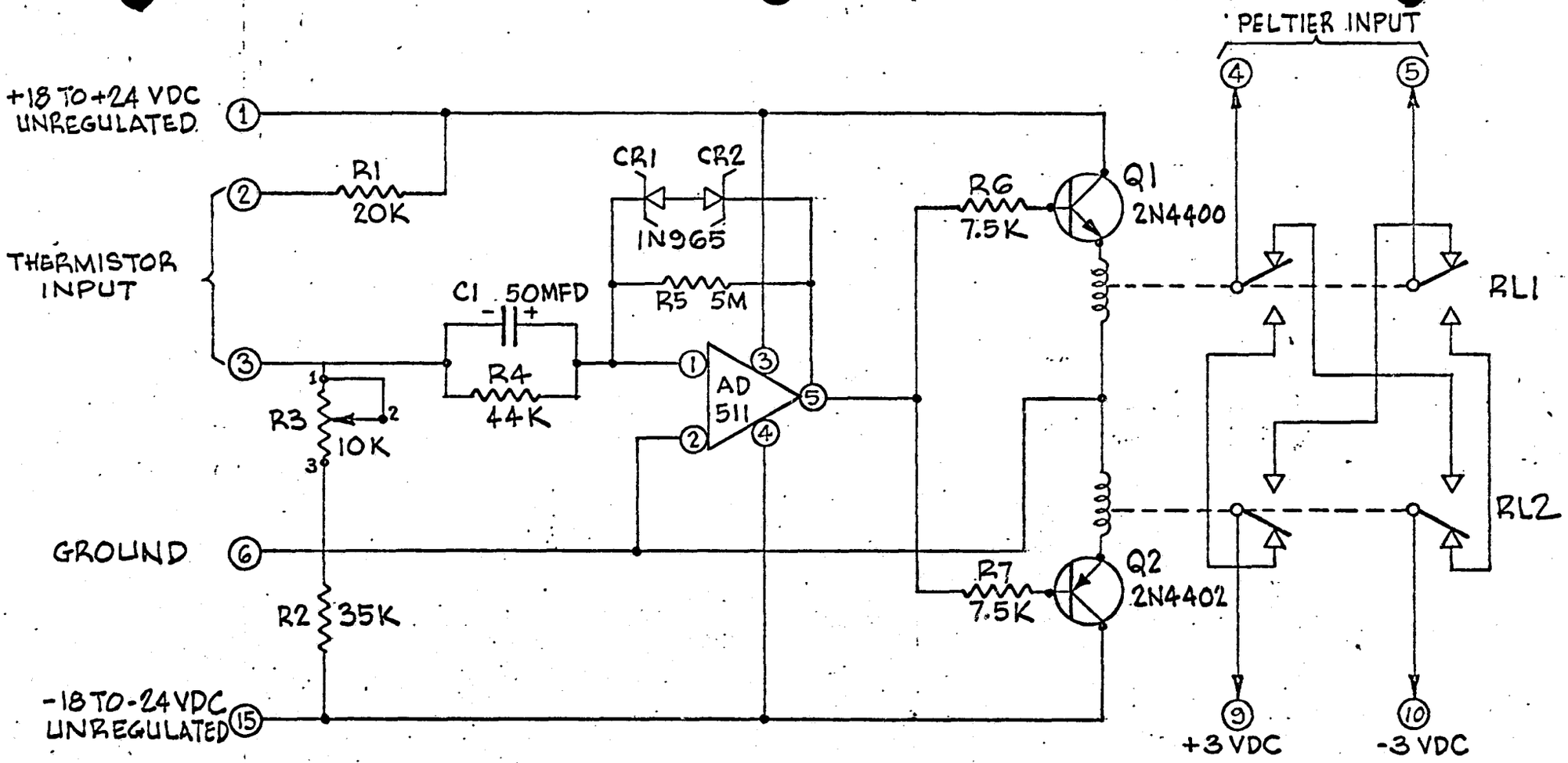
RPC CORPORATION

1222 E. GRAND AVE EL SEGUNDO, CALIF.

SCALE	REVISIONS	BY	DATE
DATE 2-10-72			
DR'N N.D.M.			

TITLE: DETECTOR PROTOTYPE - NYPD SYSTEM WIRING DIAGRAM

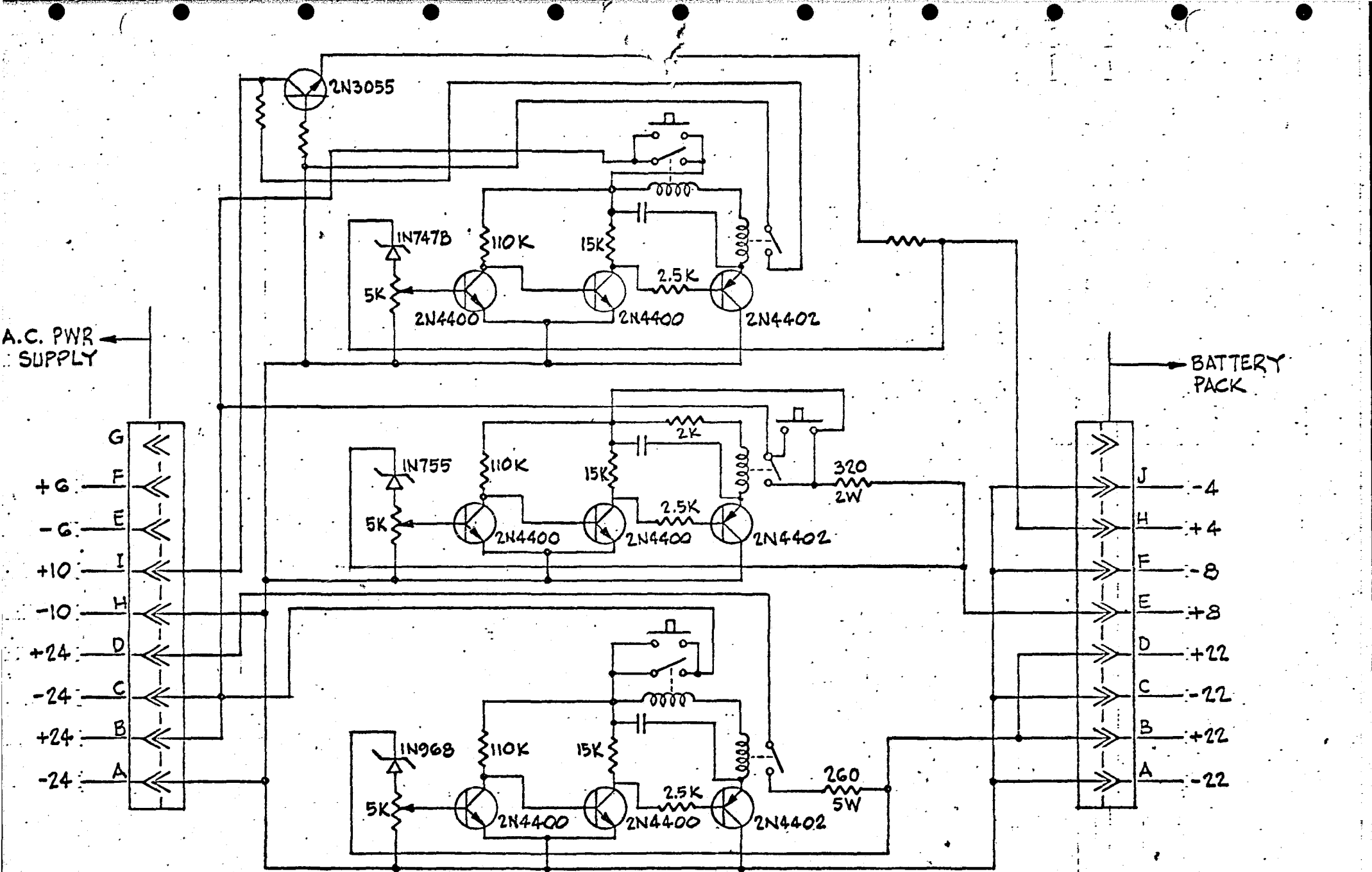
NO. 72-007



R1 & R2 ARE METAL FILM RESISTORS.
R3 POTENTIOMETER - BOURNS 200P-1-103.
RL1 & RL2, POTTER & BRUMFIELD, R40-E3-Y4-V800.

NOTES:

RPC CORPORATION 1222 E. GRAND AVE EL SEGUNDO, CALIF.			
SCALE	REVISIONS	BY	DATE
DATE 2-9-72			
DR'N WDM			
TITLE DETECTOR PROTOTYPE-NYPD TEMP. CONTROL P.C. BOARD		NO. 72-008	



NOTE: REED RELAYS SHOWN ARE MRR1A.

DETECTOR PROTOTYPE - NYPD
CHARGE CONTROLLER SCHEMATIC

W.D.M 2-16-72