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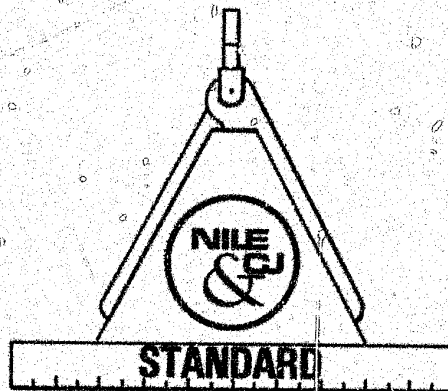
# LAW ENFORCEMENT STANDARDS PROGRAM

## SOUND SENSING UNITS FOR INTRUSION ALARM SYSTEMS

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ACQUISITIONS



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

**LAW ENFORCEMENT STANDARDS PROGRAM**

**NILECJ STANDARD  
FOR  
SOUND SENSING UNITS  
FOR  
INTRUSION ALARM SYSTEMS**

**A Voluntary National Standard Promulgated by the  
National Institute of Law Enforcement and Criminal Justice.**

**MARCH 1977**

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

**NATIONAL INSTITUTE OF LAW ENFORCEMENT  
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# NILECJ STANDARD FOR SOUND SENSING UNITS FOR INTRUSION ALARM SYSTEMS

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## FOREWORD

Following a Congressional mandate <sup>1</sup> to develop new and improved techniques, systems, and equipment to strengthen law enforcement and criminal justice, the National Institute of Law Enforcement and Criminal Justice (NILECJ) has established the Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards. LESL's function is to conduct research that will assist law enforcement and criminal justice agencies in the selection and procurement of quality equipment.

In response to priorities established by NILECJ, LESL is (1) subjecting existing equipment to laboratory testing and evaluation and (2) conducting research leading to the development of several series of documents, including national voluntary equipment standards, user guidelines, state-of-the-art surveys and other reports.

This document, NILECJ-STD-0308.00, Sound Sensing Units for Intrusion Alarm Systems, is a law enforcement equipment standard developed by LESL and approved and issued by NILECJ. Additional standards as well as other documents are being issued under the LESL program in the areas of protective equipment, communications equipment, security systems, weapons, emergency equipment, investigative aids, vehicles and clothing.

This equipment standard is a technical document consisting of performance and other requirements together with a description of test methods. Equipment which can meet these requirements is of superior quality and is suited to the needs of law enforcement agencies. Purchasing agents can use the test methods described in this standard to determine firsthand whether a particular equipment item meets the requirements of the standard, or they may have the tests conducted on their behalf by a qualified testing laboratory. Law enforcement personnel may also reference this standard in purchase documents and require that any equipment offered for purchase meet its requirements and that this compliance be either guaranteed by the vendor or attested to by an independent testing laboratory.

The necessarily technical nature of this NILECJ standard, and its special focus as a procurement aid, make it of limited use to those who seek general guidance concerning sound sensing units for intrusion alarms. The NILECJ Guideline Series is designed to fill that need. We plan to issue guidelines to this as well as other law enforcement equipment as soon as possible, within the constraints of available funding and the overall NILECJ program.

The guideline documents being issued are highly readable and tutorial in nature in contrast to the standards, which are highly technical and intended for laboratory use by technical personnel. The guidelines provide, in non-technical language, information for purchasing agents and other interested persons concerning the capabilities of equipment currently available. They may then select equipment appropriate to the performance required by their agency. Recommendations for the development of particular guidelines should be sent to us.

NILECJ standards are subjected to continuing review. Technical comments and recommended revisions are invited from all interested parties. Suggestions should be addressed to the Program Manager for Standards, National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, U.S. Department of Justice, Washington, D.C. 20531.

George Shollenberger, Manager  
Standards Program  
National Institute of Law  
Enforcement and Criminal Justice

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<sup>1</sup> Section 402(b) of the Omnibus Crime Control and Safe Streets Act of 1968, as amended.

# NILECJ STANDARD FOR SOUND SENSING UNITS FOR INTRUSION ALARM SYSTEMS

## 1. PURPOSE AND SCOPE

This standard establishes performance requirements and methods of test for sound sensing devices that respond to attack noises at frequencies up to 10 kHz and are intended for use in intrusion alarm systems to provide premise-protection of vaults and other secure areas. These devices cause the initiation of a local audible alarm or the transmission of an alarm signal to a police department or a central station. The characteristics addressed are those that affect the reliability of the device, with emphasis on those that affect its false alarm susceptibility and its tamper resistance.

## 2. CLASSIFICATION

The sound sensing units covered by this standard are of a single class, and may be obtained with the following options.

### 2.1 Option I—Pulse Counting Capability

A sound sensing device that has an impact noise integration or pulse counting capability, in addition to the ability to detect continuous attack noises in the audio frequency range.

### 2.2 Option II—Cancel Microphone Capability

A sound sensing device that incorporates cancel microphone capability.

### 2.3 Option III—EMI Resistance

A sound sensing device that will not enter the alarm state when subjected to moderate levels of radiated electromagnetic fields and conducted interference.

### 2.4 Option IV—Electrical Balance Cable Tamper Protection

A sound sensing device that monitors the impedance of one or more of its cables in order to detect tampering with the cable.

## 3. DEFINITIONS

### 3.1 Alarm State

The condition of a sound sensing unit that causes the control unit to signal an alarm.

### **3.2 Attack Noise**

Any sound generated by implements used in a physical attempt to penetrate a structure.

### **3.3 Background Noise**

The total of all ambient noise in a system or environment except an attack noise.

### **3.4 Band Center Frequency**

The geometric mean frequency of a band of frequencies. It is equal to the square root of the product of the end frequencies of the band. For example, 1000 Hz is the band center frequency of the octave band that extends from 707 to 1414 Hz, and of the third-octave band that extends from 891 to 1123 Hz.

### **3.5 Cancel Microphone**

An auxiliary microphone that is positioned so as to detect a specific non-attack background noise. The signal from this microphone is used to cancel, by electronic means, the corresponding acoustical signal received by the sensing microphone, in order to prevent response to ambient non-attack noise such as that from compressors, generators, battery chargers, fans, etc., which are in close proximity to the protected area.

### **3.6 Control Unit**

The part of a sound sensing device that provides the electronic circuitry to process the signal from the sensor and initiate an alarm signal when attack noises are detected.

### **3.7 Decibel (dB)**

A unit used to express the ratio of two like quantities which are proportional to power or energy. The ratio in decibels is equal to 10 times the logarithm to the base 10 of the ratio of the two amounts of power or energy [i.e.,  $\text{dB} = 10 \log_{10}(E_1/E_2)$ ].

When the term decibel is used to express the ratio of two like quantities which are proportional to the square root of power (e.g., sound pressure), it is equal to 20 times the logarithm to the base 10 of their ratio [i.e.,  $\text{dB} = 20 \log_{10}(P_1/P_2)$ ]. See SOUND PRESSURE LEVEL.

### **3.9 Octave Band**

A frequency band whose end frequencies have a ratio of two. For example, the end frequencies 707 Hz and 1414 Hz define an octave band.

### **3.10 Secure Mode**

The condition of a sound sensing system when all sensors and the control unit are active and ready to respond to attack sounds.

### **3.11 Sound Level (C-weighted)**

A weighted sound pressure level, obtained by the use of the metering characteristics and the weighting C specified in American National Standard S1.4-1971, "Specification for General Purpose Sound Level Meters" [1]. The reference pressure is 20 micropascals.

### **3.12 Sound Pressure**

The total instantaneous pressure in the presence of a sound wave, minus the static pressure.

### **3.13 Sound Pressure Level**

The ratio of the root-mean-square pressure of a sound to a reference pressure, expressed in decibels as 20 times the logarithm to the base 10 of this ratio; the standard reference pressure is 20 micropascals [i.e.,  $\text{dB} = 20 \log_{10} (P_1/20 \mu\text{Pa})$ ].

### **3.14 Sound Reflection Coefficient**

The ratio of the sound energy reflected by a surface to the sound energy incident upon the surface.

### **3.15 Sound Sensing Unit**

A device that is used to protect an enclosed area against break-ins by using microphones to detect sounds at frequencies below 10 kHz resulting from an attempt to penetrate the protected enclosure or area. Discrimination between break-in (attack) sounds and non-attack sounds is usually provided by controls to adjust the sensitivity to account for steady state ambient noise and, for some units, the number of impact noises necessary to initiate an alarm signal. Some devices permit the use of cancel microphones and provide controls for adjustment of their noise sensitivity; others permit one to listen to the signal from the sensing microphone at an annunciator panel.

### **3.16 Tamper Switch**

A switch that detects attempts to gain access to an alarm component through a control unit door, switch cover, junction box cover, bell housing, etc.

### **3.17 Third-Octave Band**

A frequency band whose end frequencies have a ratio of the cube root of two (approximately 1.26). For example, the end frequencies 891 Hz and 1123 Hz define a third-octave band.

### **3.18 White Noise**

A noise whose amplitude probabilities have a normal (Gaussian) distribution.

## **4. REQUIREMENTS**

### **4.1 Acceptance Criteria**

The sound sensing unit meets the requirements of this standard if all three sample specimens (see 5.1) pass all of the required tests. Pulse counting capability, cancel microphone capability, electromagnetic interference resistance, and electrical balance cable tamper protection are optional features; however, devices which incorporate these features shall meet the requirements for that option as stated in section 4. If the control unit provides separate signal processing circuitry for two or more independent sensing microphones, each circuit tested separately shall meet the requirements of this standard.



## **4.2 User Information**

The following information items shall be among those supplied to the user by the manufacturer or distributor:

- (a) Full installation and operating instructions.
- (b) The sound sensing frequency range.
- (c) The options incorporated into the device (see section 2).
- (d) The power rating.
- (e) The voltage rating.
- (f) The standby power requirements, including identification of batteries.
- (g) The minimum period of operation under standby power, and the minimum time required to fully recharge the completely discharged batteries (if so equipped).
- (h) The operation of tamper protection features.
- (i) Certification of compliance with this standard.

## **4.3 Material and Configuration**

The materials and components of the sound sensing burglar alarm system shall conform to the requirements of Underwriters Laboratories Standard UL 639, "Intrusion Detection Units" [4], sections 5 through 18.

## **4.4 Frequency Response**

When adjusted for minimum operating sensitivity and tested in accordance with paragraph 5.5, a sound sensing unit shall have maximum sensitivity to noise in the 2000 Hz octave band; and the minimum sound levels of 125, 250, and 8000 Hz octave band noise required to cause the device to enter the alarm state shall each be at least 10 dB greater than the minimum sound level of 2000 Hz octave band noise required to cause the device to enter the alarm state.

## **4.5 Minimum Sensitivity**

When adjusted for minimum operating sensitivity and tested in accordance with paragraph 5.6, the sound sensing unit shall not enter the alarm state within 30 seconds when subjected to 2000 Hz octave band noise at a sound level of 65 dB or less and shall enter the alarm state within 30 seconds when subjected to 2000 Hz octave band noise at a sound level of 85 dB or more.

## **4.6 Maximum Sensitivity**

When adjusted for maximum operating sensitivity and tested in accordance with paragraph 5.7, the sound sensing unit, subjected to 2000 Hz octave band noise at a sound level of 45 dB, shall enter the alarm state within 30 seconds.

## **4.7 Impact Noise Sensitivity (Option I Unit)**

When tested in accordance with paragraph 5.8, each Option I unit, adjusted to maximum operating impact noise sensitivity, shall not enter the alarm state in response to a single pulse within a 30 second period and shall enter the alarm state in response to either two or three pulses within a 30 second period; when adjusted to minimum operating impact noise sensitivity, the unit shall not enter the alarm state in response to one, two, or three pulses within a 30 second period and shall enter the alarm state in response to any number of pulses from four to ten within a 30 second period.

## **4.8 Stability**

When subjected to the exceptional operating conditions in accordance with paragraphs 5.9.3 through 5.9.7, and tested in accordance with paragraph 5.9.2, the minimum sound level required to cause the sound sensing unit to enter the alarm state shall not change by more than 3 dB from that set in accordance with paragraph 5.9.1.

## **4.9 Standby Power Operation**

When tested in accordance with paragraph 5.9.8, the sound sensing unit shall not enter the alarm state when the line voltage is interrupted or restored; the minimum sound level required to cause the sound sensing unit to enter the alarm state, when operated from the standby power supply for the period of time specified by the manufacturer (paragraph 4.2.g); shall not change from that set in accordance with paragraph 5.9.1 by more than 3 dB; the unit shall not enter the alarm state during the period of continuous operation from standby power; and when reconnected to line voltage following the period of standby operation, sound sensing units equipped with recharging systems shall function normally during the recharging period and the recharging circuit shall fully recharge the batteries in the period of time specified by the manufacturer.

## **4.10 Cancel Microphone Operation (Option II Unit)**

Each sound sensing unit with cancel microphone capability shall include controls to adjust the sensitivity of the cancel microphone. When tested in accordance with paragraph 5.10, it shall not enter the alarm state within 30 seconds in the presence of a 2000 Hz octave band sound level of 65 dB, and shall enter the alarm state within 30 seconds in the presence of a 2000 Hz octave band sound level of 85 dB, while the cancel microphone is being subjected to a 70 dB sound level of either 1600, 2000, or 2500 Hz third-octave band noise.

## **4.11 Electromagnetic Interference Susceptibility (Option III Unit)**

Each sound sensing unit with Option III EMI resistance shall not enter the alarm state when subjected to radiated electromagnetic fields and conducted interference in accordance with paragraph 5.11.

## **4.12 Tamper Switch**

Each sound sensing unit control unit shall incorporate tamper switch protection. When tested in accordance with paragraph 5.12.1, the tamper switch shall not cause the unit to signal an alarm until the cover or cover screw, whichever actuates the tamper switch, has moved at least 1.5 mm (0.06 in) and shall cause the device to signal an alarm before the cover or cover screw has moved a sufficient distance to permit a direct line of sight to electrical circuits or adjustment controls.

Remote microphone boxes that incorporate tamper switch protection shall also meet the above requirements.

## **4.13 Cable Tamper Protection**

Each sound sensing unit shall incorporate cable tamper protection and, when tested in accordance with paragraph 5.12.2, shall signal an alarm when the remote microphone cable is disconnected from the control unit and shall signal an alarm when an electrical short is connected between the microphone terminals.

#### **4.14 Electrical Balance Cable Protection (Option IV Unit)**

When tested in accordance with paragraph 5.12.3, the sound sensing unit shall enter the alarm state for a change in impedance of the monitored lines as specified by the manufacturer (paragraph 4.2.h) and, when subjected to temperatures from  $0 \pm 2^{\circ}\text{C}$  ( $32 \pm 3.6^{\circ}\text{F}$ ) to  $50 \pm 2^{\circ}\text{C}$  ( $122 \pm 3.6^{\circ}\text{F}$ ), the change in both the impedance of the monitored cable and the sensitivity of the control unit electrical balance circuit shall not exceed 20 percent of the minimum impedance change which will cause the device to enter the alarm state under standard test conditions (paragraph 5.2).

### **5. TEST METHODS**

#### **5.1 Sampling**

Three sound sensing units shall be selected at random for testing. Each device shall include the power supply, microphone, and associated sensing and alarm actuating circuitry.

#### **5.2 Test Conditions**

Unless otherwise specified, all tests shall be performed with the sound sensing unit operated at its specified normal operating voltage and in the laboratory ambient environment.

#### **5.3 Test Equipment**

##### **5.3.1 Sound Measuring Equipment**

The sound measuring equipment shall meet the Type I, C weighting specifications of American National Standard S1.4-1971, "Specification for General-Purpose Sound Level Meters" [1].

##### **5.3.2 Filter Sets**

The octave and third-octave band filter sets shall meet the requirements of American National Standard S1.11-1966 (R1971) "Octave, Half-Octave, and Third-Octave Band Filter Sets" [2].

##### **5.3.3 Random Noise Generator**

The noise generator shall generate signals which constitute completely random white noise,  $\pm 1$  dB, from 88 Hz to 12 kHz.

##### **5.3.4 Timer**

The timer shall have an isolated single-pole double-throw relay with independent adjustment of the cycle time spent in each position. The times for each position shall be adjustable from 0.2 to 60 seconds with an error of less than 3 percent of the set value plus 0.02 second.

##### **5.3.5 Amplifier**

The amplifier shall have a frequency response which is flat to within 2 dB from 100 Hz to 12 kHz at a rated power output of at least 75 watts rms.

### **5.3.6 Speaker**

The speaker shall have a frequency response which is flat to within 5 dB from 100 Hz to 12 kHz and shall be capable of providing an output in the test chamber of 90 dB in the third-octave band with band center frequency of 1 kHz.

### **5.3.7 Environmental Test Chambers**

The environmental test chamber, or chambers, shall be of a size sufficient to accommodate the sound sensing device and shall be able to maintain temperatures of  $0 \pm 2^\circ\text{C}$  ( $32 \pm 3.6^\circ\text{F}$ ) and  $50 \pm 2^\circ\text{C}$  ( $122 \pm 3.6^\circ\text{F}$ ).

### **5.3.8 Acoustic Test Chamber**

The acoustic test chamber shall consist of a rectangular enclosure with a minimum volume of  $7.0 \text{ m}^3$  (about  $250 \text{ ft}^3$ ) and a minimum linear dimension of 1.5 m (5 ft). The ratio of the maximum to the minimum dimension shall be less than 3. Its interior surfaces shall have an average sound reflection coefficient of more than 0.94 at each test frequency. The background noise level shall be at least 10 dB less than that of the white noise being used for test.

## **5.4 Sound Level Measurement Procedure**

Set up the equipment as shown in figure 1 for all tests in which the response of the unit to specific noise is to be determined. In the acoustic test chamber (paragraph 5.3.8), opposite the speaker, place both the sensing microphone of the unit and a reference microphone which meets the requirements of paragraph 5.3.1. Place the microphones at least 0.7 m (2.3 ft) from all surfaces, but not near the geometric center of the chamber and no more than 10 cm (4 in) apart. Connect the sensing microphone to the control unit with a 10 m (32.8 ft) length of the cable specified by the manufacturer and in accordance with installation instructions. Adjust the sensitivity control of the unit as required by each individual test, and set all other controls at their middle positions unless otherwise specified by the manufacturer.

Conduct tests using a single sensing microphone and a single cancel microphone.

Reduce the sound level within the acoustic test chamber to 35 dB or less for a one minute period prior to each test of the response of the device to a specific noise.

## **5.5 Frequency Response Test**

Set up the equipment (paragraph 5.4) and set the sound sensitivity adjustment of the device at its minimum operating sensitivity level. Generate an octave band of white noise at a band center frequency of 2000 Hz and determine the minimum sound level which will cause the unit to enter the alarm state within 30 seconds.

Repeat, using octave bands of white noise at band center frequencies of 125 Hz, 250 Hz, and 8000 Hz.

## **5.6 Minimum Sensitivity Test**

Set up the equipment (paragraph 5.4) and set the sound sensitivity of the device at its minimum operating sensitivity level. Generate an octave band of white noise at a band center frequency of 2000 Hz and a sound level of  $65 \pm 1 \text{ dB}$  and observe whether the unit enters the alarm state within 30 seconds. Repeat the above test at a sound level of  $85 \pm 1 \text{ dB}$ .

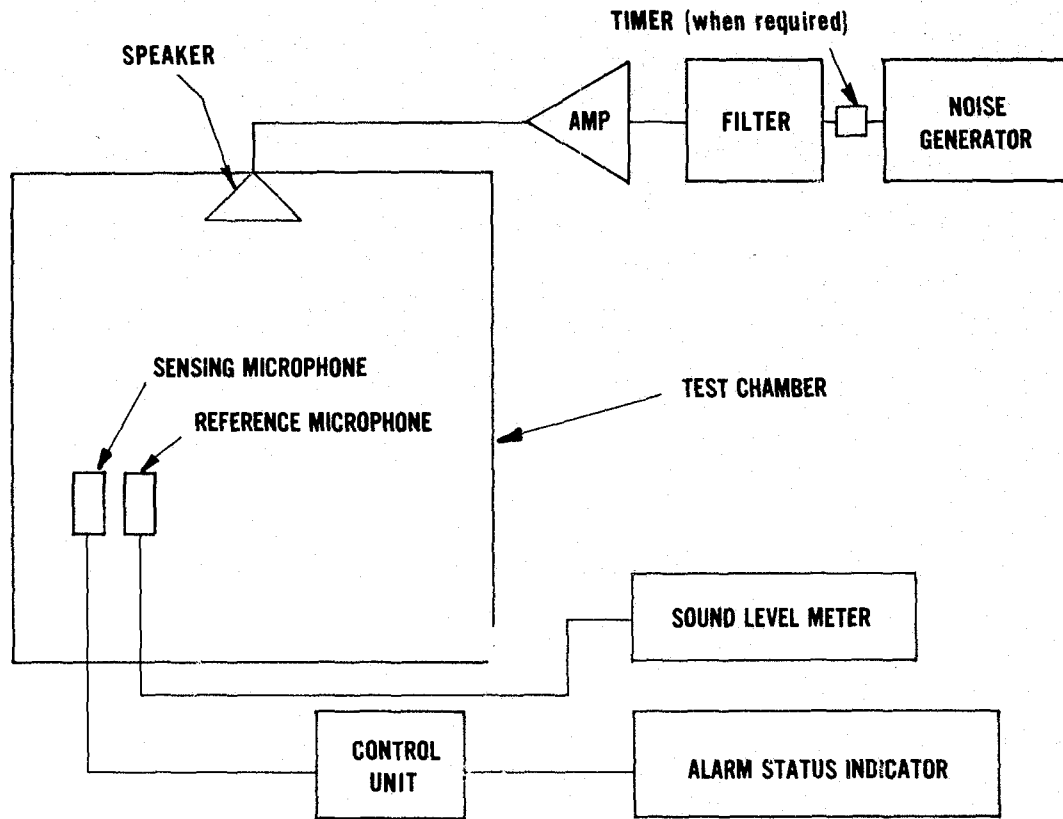


FIGURE 1. Equipment Arrangement for Sound Sensing Capability Tests

### 5.7 Maximum Sensitivity Test

Set up the equipment (paragraph 5.4) and set the sound sensitivity of the device at its maximum operating sensitivity level. Generate an octave band of white noise at a band center frequency of 2000 Hz and a sound level of  $45 \pm 2$  dB and observe whether the unit enters the alarm state within 30 seconds.

### 5.8 Impact Noise Sensitivity Test (Option I Only)

Set up the equipment (paragraph 5.4), adjust the sound sensitivity control as described in paragraph 5.9.1, and adjust the impact noise integration or pulse counting control to the minimum count level (maximum operating sensitivity). Adjust the amplifier and set the filter to provide a  $90 \pm 1$  dB level of 2000 Hz octave band noise. Set the timer on cycle (noise) to  $0.5 \pm 0.1$  second and the off cycle (no noise) to  $30 \pm 1$  seconds. Generate five pulses of noise and observe whether the unit enters the alarm state. Repeat this test two additional times, waiting at least 60 seconds between tests.

Reset the timer off cycle to  $10.0 \pm 0.2$  seconds, generate three pulses and observe whether the unit enters the alarm state. Repeat this test two additional times, waiting at least 60 seconds between tests.

Adjust the impact noise integration or pulse counting control to the maximum count level (minimum operating sensitivity). With the timer cycle still set at 0.5 second on and 10.0 seconds off, generate three pulses and observe whether the unit enters the alarm state. Repeat this test two additional times, waiting at least 60 seconds between tests. Adjust the timer cycle to  $0.5 \pm 0.1$  second on and  $2.5 \pm 0.1$  seconds off, generate ten pulses and observe whether the unit enters the alarm state. Repeat this test two additional times, waiting at least 60 seconds between tests.

## 5.9 Stability Tests

### 5.9.1 Initial Adjustment

Adjust the sound sensitivity of the unit so that an octave band of white noise at a band center frequency of 2000 Hz at a sound level of  $55 \pm 1$  dB will cause the unit to enter the alarm state, and a sound level of  $52 \pm 1$  dB will not cause the unit to enter the alarm state. If the unit has stepped incremental adjustments, use the nearest equivalent step, and determine the minimum sound level which will cause the unit to enter the alarm state at that setting.

### 5.9.2 Procedure

After each change in an operating condition in accordance with paragraphs 5.9.3 to 5.9.7, without adjusting the sensitivity of the test specimen, generate an octave band of white noise at a band center frequency of 2000 Hz and determine the minimum sound level which will cause the unit to enter the alarm state within 30 seconds.

### 5.9.3 High Voltage Test

Test each unit in accordance with paragraph 5.9.2 with an input voltage of  $110 \pm 1$  percent of the nominal operating voltage.

### 5.9.4 Low Voltage Test

Test each unit in accordance with paragraph 5.9.2 with an input voltage of  $85 \pm 1$  percent of the nominal operating voltage.

### 5.9.5 High Temperature Test

Place the control unit in an environmental test chamber (paragraph 5.3.7) at a temperature of  $50 \pm 2^\circ\text{C}$  ( $122 \pm 3.6^\circ\text{F}$ ). Place the microphone in the acoustic test chamber (paragraph 5.4). Allow the control unit to remain at temperature for a minimum of 3 hours and then, while it is at the test temperature, test the sound sensing unit in accordance with paragraph 5.9.2.

### 5.9.6 Low Temperature Test

Place the control unit in an environmental test chamber (paragraph 5.3.7) at a temperature of  $0 \pm 2^\circ\text{C}$  ( $32 \pm 3.6^\circ\text{F}$ ). Place the microphone in the acoustic test chamber (paragraph 5.4). Allow the control unit to remain at temperature for a minimum of 3 hours and then, while it is at the test temperature, test the sound sensing unit in accordance with paragraph 5.9.2.

### 5.9.7 Shock Test

Disconnect the sound sensing unit from line voltage, and remove the chassis and front panel assembly from the control unit as for servicing. Place it on a bench with a horizontal solid wooden top at least 4 cm (1 5/8 in) thick. Using one edge as a pivot, lift the opposite edge of the chassis until the chassis forms an angle of 45 degrees with the bench top, or the lifted edge has been raised 10 cm (4 in) above the horizontal bench top, or the lifted edge of the chassis is just below the point of perfect balance, whichever condition occurs first. Then let the chassis drop back freely to the bench top. Repeat, using other practical edges of the same horizontal chassis face as the pivot edges, for a total of four drops.

Repeat this entire procedure with the chassis resting on other faces until it has been dropped a

total of four times on each face on which the chassis could be practically placed during servicing. Then test the sound sensing unit in accordance with paragraph 5.9.2.

#### **5.9.8 Standby Power Test**

Disconnect the unit from the power line and permit it to operate from its fully charged standby power supply. Observe whether the unit enters the alarm state, wait one minute, reconnect the unit to the power line, and again observe whether the unit enters the alarm state. Repeat that test two additional times. Then allow it to operate continuously from the standby power supply for the period of time specified by the manufacturer (4.2.g). Introduce no noise into the acoustic test chamber during this period of operation, but record the output of the sound pressure measuring equipment. Upon completion of the required operating period, test the device in accordance with paragraph 5.9.2.

If the unit enters the alarm state during the period of non-test continuous operation, examine the record of the sound pressure measuring equipment; if the sound level had not exceeded 52 dB, the unit fails the test.

If the unit incorporates a battery charging circuit, connect it to line voltage and again test it in accordance with paragraph 5.9.2. Allow it to operate continuously for the period of time specified by the manufacturer as that required to fully charge the batteries (paragraph 4.2.g) and then repeat the standby power operation test as described in the preceding paragraphs.

#### **5.10 Cancel Microphone Test (Option II Only)**

Set up the equipment (paragraph 5.4) and set the sound sensitivity of the unit at its minimum sensitivity level. Connect the cancel microphone, place it anywhere except in the acoustic test enclosure and adjust it in accordance with the manufacturer's instructions. Subject the sound sensing microphone to an octave band of white noise at a band center frequency of 2000 Hz and sound levels of first  $65 \pm 1$  dB and then  $85 \pm 1$  dB. Simultaneously subject the cancel microphone to a third-octave band of white noise at a band center frequency of 1600 Hz and a sound level of  $70 \pm 1$  dB, and observe in both tests whether the unit enters the alarm state within 30 seconds. Then repeat these two tests, with the cancel microphone subjected to third-octave bands centered at 2000 Hz and then at 2500 Hz, for a total of six tests.

#### **5.11 Electromagnetic Susceptibility Tests (Option III Only)**

Conduct the electromagnetic susceptibility tests (paragraphs 5.11.1 and 5.11.2) in a facility with a background noise level of less than 45 dB, and adjust the sensitivity of the device in accordance with paragraph 5.9.1.

##### **5.11.1 Radiation Susceptibility Test**

Subject the unit to radiation in accordance with MIL-STD-462, Notice 3 [3], test method RS03. Use an electric field of 1 V/m from 10 kHz to 2 MHz and 3 V/m from 2 MHz to 12 GHz. Observe whether the unit enters the alarm state.

##### **5.11.2 Conducted Susceptibility Test**

Subject the unit to conducted interference in accordance with MIL-STD-462, Notice 3 [3], test methods CS02 and CS06. Conduct test CS06 maintaining a constant test signal of 1 volt rms, rather than constant apparent power. Observe whether the unit enters the alarm state.

## 5.12 Tamper Resistance Tests

### 5.12.1 Tamper Switch Test

If the unit has a hinged cover, swing it open until the tamper switch is actuated, and measure the displacement of the cover opposite the hinge. If the unit has a non-hinged cover, lift one side until the tamper switch is actuated, and measure the displacement of that side of the cover. Repeat this for each of the other three sides and calculate the average displacement of the four sides. If the unit has a non-hinged cover which cannot be lifted one side at a time, lift or move it uniformly until the tamper switch is actuated, and measure the displacement of the cover. If the unit has a tamper switch actuated by the motion of the cover screws, retract each screw until the tamper switch is actuated, and measure the average displacement of the screws.

In each case, examine the unit while the cover is lifted to the position just insufficient to actuate the tamper switch, and determine if there is a direct line of sight to any internal adjustment control or electrical circuitry which would allow the use of a thin tool to tamper with the controls or circuits.

### 5.12.2 Cable Tamper Protection Test

With the sound sensing unit operating in the secure mode, disconnect the microphone cable and observe whether the device enters the alarm state. Then, with the microphone connected, place an electrical short across the microphone terminals and observe whether the device enters the alarm state.

### 5.12.3 Electrical Balance Test (Option IV Only)

From the information supplied by the manufacturer (paragraph 4.2.h), identify the terminal points in the remote microphone box which provide the reference impedance for the electrical balance tamper circuit in the control unit and its appropriate parameter (resistance, inductance or capacitance).

Disconnect the monitored lines from the control unit electrical balance circuit and measure the impedance of these lines at laboratory ambient temperature to an uncertainty of  $\pm 3$  percent or less. Unless otherwise specified by the manufacturer, measure capacitance at a test frequency of 100 kHz; inductance at a test frequency of 1 kHz; and dc resistance. Then connect an appropriate variable impedance device (resistor, inductor, or capacitor) to the control unit electrical balance circuit, adjust it to the measured impedance of the monitored line and determine the minimum change in impedance which will cause the control unit to signal an alarm. Place the control unit, microphone and cable in an environmental test chamber at  $0 \pm 2^\circ\text{C}$  ( $32 \pm 3.6^\circ\text{F}$ ), maintain them at that temperature for three hours, and then repeat the measurement of the impedance of the monitored line and the impedance change required to cause the control unit to signal an alarm. Repeat at  $50 \pm 2^\circ\text{C}$  ( $122 \pm 3.6^\circ\text{F}$ ).

## APPENDIX—REFERENCES

1. American National Standard S1.4-1971, *Specification for General-Purpose Sound Level Meters*. Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.
2. American National Standard S1.11-1966 (R1971), *Octave, Half-Octave and Third-Octave Filter Sets*. Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.
3. MIL-STD-462, *Measurements of Electromagnetic Interference Characteristics*, August 1, 1968, and Notice 3, February 9, 1971. Available from the Naval Publication and Form Center, 5801 Tabor Avenue, Philadelphia, Pa. 19120.
4. Underwriters Laboratories Standard UL 639, *Intrusion Detection Units*, third edition, Dec. 1971. Available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, Ill. 60062.



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The following publications of the Law Enforcement Standards Program issued by the National Institute of Law Enforcement and Criminal Justice are for sale by the U.S. Government Printing Office. For information concerning the availability and price of any of the publications write to: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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0207.00	Mobile FM Receivers, June 1975	027-000-00344-3
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0105.00	Crash Helmets, June 1975	027-000-00347-8
0212.00	RF Coaxial Cable Assemblies for Mobile Transceivers, September 1975	027-000-00357-5
0206.00	Fixed and Base Station FM Receivers, September 1975	027-000-00358-3
0208.00	Personal/Portable FM Receivers, October 1975	027-000-00366-4
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0202.00	Batteries Used With Law Enforcement Communications Equipment—Chargers and Charging Techniques, June, 1973	027-000-00216-1
0203.00	Technical Terms and Definitions Used With Law Enforcement Communications Equipment, June 1973	027-000-00214-5
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