

**ON-HOOK TELEPHONE AUDIO SECURITY
PERFORMANCE SPECIFICATION**

TSG STANDARD 5

MARCH 1990

PREFACE

The Telephone Security Group (TSG) prepared this standard. The charter members of the TSG are: Department of the Air Force, Department of the Army, Central Intelligence Agency, Defense Intelligence Agency, Department of Energy, Federal Bureau of Investigation, Department of the Navy , National Security Agency US Secret Service, and Department of State.

The TSG is the primary technical and policy resource in the US Intelligence Community for all aspects of the TSCM (technical surveillance countermeasures) program involving telephone systems. The TSG standards contain guidance for providing on-hook security to telephone systems in areas where sensitive government information is discussed. Implementation of TSG standards neither prevents the application of more stringent requirements nor satisfies the requirements of other security programs such as TEMPEST, COMSEC, or OPSEC.

TSG Standard I is an introduction to telephone security~ that provides general information about the TSG standards.

ON-HOOK TELEPHONE AUDIO

SECURITY PERFORMANCE SPECIFICATIONS

PURPOSE

This standard specifies the minimum required performance for a telephone that can be located in a sensitive discussion area without supplementary on-hook audio security measures. The technical performance requirements expressed in this standard are included as a part of the type-acceptance criteria of Standards 3 and 4.

APPLICABILITY

The acceptance criteria and tests presented in this standard are for use in manufacturing and procurement of telephone instruments. These criteria are not intended for the testing and examination of installed units.

SPECIFICATIONS

The telephone must comply with the performance specifications (intrinsic on-hook microphonics, resistance to modification, and verifiable security) for all the following configurations:

- Disconnected from its host system or network with no power applied.
- Disconnected from its host system or network, but fully powered and operationally ready.
- Connected to its host system or network, fully powered, and operationally ready.

1. Intrinsic On-Hook Microphonics

a. While on-hook, the telephone must not be able to pick up and transmit audio to the mounting cord.

The telephone instrument must not exhibit intrinsic microphonic behavior with respect to any of the wires leaving the body of the instrument. The non-microphonic characteristic must be sustained independent of all environmental stimuli, including acoustic and electromagnetic fields, voltages, or commands that could be impressed on mounting cord or power supply wires.

Without a manual action by the user, neither the system nor an incoming call is permitted to alter the telephone's nonmicrophonic characteristics or cause it to be offhook.

b. The purpose for testing microphonic behavior under this standard is not to identify or study individual microphonic components, but to measure the level of microphonic response for the whole instrument. With respect to microphonics, the telephone is considered to be an elemental microphone. The microphonic response is measured at the mounting cord of the instrument. When the instrument is excited by a sound pressure field, the microphonic response presents signal voltages at the mounting cord wires. The ground referenced voltage is to be measured at every conductor leaving the instrument. Also, the differential voltage for all pair-wise combinations of conductors must be measured to fully quantify the microphonic response. This set of voltage measurements is performed while the instrument is subjected to an acoustic excitation at a specified sound pressure level.

c. The pressure response level of a microphone is the ratio of voltage output to sound pressure level (SPL) input. The voltage measurement is generally specified as an open-circuit measurement. For purposes of this specification, the internal loading on the wires being tested may be taken into consideration in configuring the voltage measuring equipment. The test equipment input resistance must equal or exceed the on-hook terminating impedance inside the telephone. Regardless of the actual internal terminating impedance, a test equipment impedance in excess of 100 k Ω is neither required nor prohibited. The minimum allowed impedances for various conditions are shown in Table 1.

TABLE 1

TERMINATING IMPEDANCE INSIDE TELEPHONE	MINIMUM ALLOWED IMPEDANCE FOR TEST EQUIPMENT
$Z \leq 100 \text{ k}\Omega$	Z
$Z \geq 100 \text{ k}\Omega$	100 k Ω

d. A response of 0.5 microvolts/pascal is the maximum sound pressure response that is allowed for a telephone that is to be connected to uncontrolled lines. When the response is measured in volts and the SPL in pascals, the pressure response level is obtained by dividing the input SPL into the output voltage.

$$[\text{Microvolts}] / [\text{pascals}] \leq 0.5$$

When decibels are used to express both the SPL and response voltage, the pressure response level may be obtained by subtracting the input SPL [dB] from the output voltage [dB]. If the voltage is measured in dB above one microvolt and the SPL in dB above 20 micropascals, the maximum allowed pressure response level becomes -100 dB.

$$[\text{dB}\mu\text{V}] - [\text{dB SPL}] \leq -100 \text{ dB}$$

e. The telephone may be tested at any convenient SPL provided that accurate voltage measurements can be accomplished with the necessary resolution. Compliance with these requirements can normally be accomplished using an input SPL of 100 dB (2 pascals) or greater. Lower sound pressure levels require the ability to perform calibrated audio-frequency voltage measurements of less than one microvolt. Examples of the maximum allowed response voltages for various test SPL values are shown in Table 2.

TABLE 2

TEST SPL		MAXIMUM ALLOWED RESPONSE	
dB*	Pascals	Microvolts (μV)	DBμV
60	0.020	0.01	-40
70	0.063	0.03	-30
80	0.20	0.1	-20
90	0.63	0.3	-10
94	1.0	0.5	-6
100	2.0	1	0
110	6.3	3	+10

*[dB above 20 micropascals]

f. The specified on-hook microphonic performance is required over the frequency range 200-6000 Hertz (Hz). The actual testing to demonstrate compliance with these specifications may be conducted by measurements taken either at discrete frequencies or with a continuous frequency sweep over the required range. The continuous frequency sweep is preferred. If discrete frequencies are used, below 400 Hz the measurements may be made at intervals not to exceed one-half octave; above 400 Hz the frequency intervals are not to exceed one-third octave. The equivalent impedance (from 200 to 6000 Hz) of all the terminations, devices, and test equipment connected to the particular wire/wire or wire/ground combination being tested must comply with Table 1.

2. Resistance to Modification

The ideal condition for on-hook audio security is that the telephone cannot by any means be caused to produce audio when it is on-hook. For real telephones, however, there is always a possibility that accidental or deliberate modifications to an otherwise approved instrument could cause it to pass audio. Measures to minimize this possibility must be applied.

a. The design and construction of a telephone must not facilitate any modification that could cause it to pass audio or become microphonic while on-hook.

b. The telephone's internal components must be situated so that the instrument's on-hook isolation cannot be easily or covertly bypassed.

c. The internal component layout of the telephone must facilitate countermeasures inspection to find potentially compromising modifications.

With the cover removed, a desirable internal layout would present critical components and connections in clear view. The layout would facilitate inspection to such a degree that any added conductors or implanted components would be found immediately. A compromising modification could be readily identified because all connections critical to on-hook security would be visible.

On-hook audio security is compromised when a microphonic element becomes connected to, or transfers audio to the external wires. Therefore, components and circuit traces that are connected to any transducer or microphonic element must not be located adjacent to components or circuit traces that connect to external wires.

d. To support the above inspection requirement, there should be no unnecessary enclosed spaces that prevent inspection.

e. There must be no unnecessary or spare wires leaving the telephone.

f. If a telephone set is computerized, or is a part of a computerized telephone system, it is *not* permissible for any software change to cause the telephone to pass audio or become microphonic.

3. Verifiable Security

a. The construction of the telephone set must provide a means for the physical and electrical inspection at any time: before, during, or after installation. All components that provide on-hook audio isolation must function properly. All security functions must be verifiable by either physical inspection or electrical measurement, or both.

b. The telephone must be capable of sustaining repeated disassembly without physical damage or deterioration occurring.

c. If electrical test points are required to test the components that provide isolation, these test points must be placed so that they can be safely accessed in all normal operating configurations.

d. Production changes and modifications, or repairs to existing telephone instruments, must not diminish compliance with these specifications.

GLOSSARY

PRELIMINARY NOTE

The definitions in this glossary are for use with the TSG standards only. They are provided to ensure a precise, unambiguous meaning for terms used to describe TSG requirements. Many of the terms used have no related meaning in any other context. Where terms are involved that are employed by the telephone industry, the usages given are intended to be consistent with most common industry practices. Usage, however, can vary significantly from company to company, and this glossary is not a definitive study of all the ways in which these terms may be used. It is important in using the TSG standards, that these terms not be given any more or any less meaning than is specified here.

CTS (COMPUTERIZED TELEPHONE SYSTEM)

A generic term used to describe any telephone system that uses centralized stored program computer technology to provide switched telephone networking features and services. CTSs are referred to commercially by such terms as computerized private branch exchange (CPBX), private branch exchange (PBX), private automatic branch exchange (P ABX), electronic private automatic branch exchange (EP ABX), computerized branch exchange (CBX), computerized key telephone systems (CKTS), hybrid key systems, business communications systems, and office communications systems.

MANUAL ACTION

An action that requires that the user touch, move, lift, or otherwise manipulate by hand, some control or part of the telephone. An operation that is actuated by the user's voice does not qualify as a manual action.

MICROPHONE

Any component among whose intended functions include performing as a transducer to produce an electrical analogue output from an audio-frequency sound pressure waveform input.

MICROPHONIC

Any component, regardless of its intended functions, that exhibits transducer behavior to produce an electrical analogue output from an audio-frequency sound pressure waveform input is termed microphonic.

NETWORK SYSTEM

An assembly of member terminals, control facilities, and intercommunication facilities that can establish and maintain a communications link between any two of the member terminals.

OFF-HOOK (TELEPHONE)

A telephone in the in-use state.

ON-HOOK AUDIO SECURITY

ON-HOOK TELEPHONE AUDIO SECURITY

The use of positive measures to protect on-hook telephones against passing room audio is known as on-hook audio security or on-hook telephone audio security.

ON-HOOK (TELEPHONE)

A telephone in the idle state.

PRESSURE RESPONSE LEVEL

The pressure response level of a microphone is the ratio of voltage output to sound pressure level input.

STANDARD MOUNTING CORD

A flexible assembly of individually insulated electrical wires enclosed in a common insulating jacket and fitted with terminating connectors: used to provide the electrical connections between the main body of the telephone and the blocks or jacks that terminate the house cabling.

TELEPHONE

A voice terminal that, regardless of whatever other functions it performs, is a member terminal of a telephone network and accomplishes all the incoming and outgoing signaling and voice interfacing necessary for operation in that network.

TRANSDUCER

A component of the telephone that either converts electrical signals to acoustic signals or acoustic signals to electrical signals: includes microphones, ringers, speakers, and speaker-microphones.

UNCONTROLLED LINE

A telephone wireline that is not provided continuous positive physical protection against unauthorized, clandestine intercept of the information it is being used to convey.