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Guide for the Selection of Communication Equipment for Emergency First Responders

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Guide for the Selection of Communication Equipment for Emergency First Responders

NIJ Guide 104–00, Volume I

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FOREWORD

The Office of Law Enforcement Standards (OLES) of the National Institute of Standards and Technology (NIST) furnishes technical support to the National Institute of Justice (NIJ) program to support law enforcement and criminal justice in the United States. OLES's function is to develop standards and conduct research that will assist law enforcement and criminal justice agencies in the selection and procurement of quality equipment.

OLES 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 standards, user guides, and technical reports.

This document covers research conducted by OLES under the sponsorship of NIJ. Additional reports as well as other documents are being issued under the OLES program in the areas of protective clothing and equipment, communication systems, emergency equipment, investigative aids, security systems, vehicles, weapons, and analytical techniques and standard reference materials used by the forensic community.

Technical comments and suggestions concerning this guide are invited from all interested parties. They may be addressed to the Office of Law Enforcement Standards, National Institute of Standards and Technology, 100 Bureau Drive, Stop 8102, Gaithersburg, MD 20899–8102.

Sarah V. Hart, Director
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COMMONLY USED SYMBOLS AND ABBREVIATIONS

A	ampere	h	hour	oz	ounce
ac	alternating current	hf	high frequency	o.d.	outside diameter
AM	amplitude modulation	Hz	hertz	Ω	ohm
cd	candela	i.d.	inside diameter	p.	page
cm	centimeter	in	inch	Pa	pascal
CP	chemically pure	IR	infrared	pe	probable error
c/s	cycle per second	J	joule	pp.	pages
d	day	L	lambert	ppm	parts per million
dB	decibel	L	liter	qt	quart
dc	direct current	lb	pound	rad	radian
°C	degree Celsius	lbf	pound-force	rh	relative humidity
°F	degree Fahrenheit	lbf·in	pound-force inch	s	second
dia	diameter	lm	lumen	SD	standard deviation
emf	electromotive force	ln	logarithm (base e)	sec.	Section
eq	equation	log	logarithm (base 10)	SWR	standing wave ratio
F	farad	M	molar	uhf	ultrahigh frequency
fc	footcandle	m	meter	UV	ultraviolet
fig.	Figure	μ	micron	V	volt
FM	frequency modulation	min	minute	vhf	very high frequency
ft	foot	mm	millimeter	W	watt
ft/s	foot per second	mph	miles per hour	N	newton
g	acceleration	m/s	meter per second	λ	wavelength
g	gram	mo	month	wk	week
gal	gallon	N·m	newton meter	wt	weight
gr	grain	nm	nanometer	yr	year
H	henry	No.	number		

area=unit^2 (e.g., ft^2, in^2, etc.); volume=unit^3 (e.g., ft^3, m^3, etc.)

ACRONYMS SPECIFIC TO THIS DOCUMENT

APCO	Association of Public Safety Communications Officials	MHz	Megahertz
CB	Citizens Band	PCS	Personal Communication System
CTCSS	Continuous Tone Coded Squelch System	PMR	Private Mobile Radio
DCS	Digital Code Squelch	PTT	Push-to-Talk
EDACS	Enhanced Digital Access Communications Systems	RF	Radio Frequency
GHz	Gigahertz	SMR	Shared Mobile Radio
I.S.	Intrinsically Safe	TETRA	Terrestrial Trunked Radio
LMR	Land Mobile Radios	VOX	Voice Operated Switch
LTR	Logic Trunked Radio		

DEFINITIONS RELEVENT TO THIS DOCUMENT

CDMA	Code Division Multiple Access is a method of subdividing a band to permit access to the same frequency for multiple users.
TMDA	Time Division Multiple Access is a method of subdividing a band to permit access to the same frequency for multiple users.
ISM Bands	Nonlicensed/nonexclusive frequency bands for Industrial, Scientific, and Medical applications. Frequency bands (902 MHz to 928 MHz, 2.40 GHz to 2.483 GHz) set aside for low-power devices (also referred to as “Part 15” devices).
DSSS	Direct Sequence and Spread Spectrum (an RF transmission scheme to permit multiple, coordinated users to operate in the same band).
FHSS	Frequency Hopping and Spread Spectrum (an RF transmission scheme to permit multiple, coordinated users to operate in the same band).
PASS	Personal alarm system, or warning device, worn by individuals.
Duplex	Real or perceived simultaneous transmit and receive.
Half-duplex	Continuous receive of all transmitted information and a transmit frequency/time slot/code shared with others.

PREFIXES (See ASTM E380)

d	deci (10^{-1})	da	deka (10)
c	centi (10^{-2})	h	hecto (10^{2})
m	milli (10^{-3})	k	kilo (10^{3})
µ	micro (10^{-6})	M	mega (10^{6})
n	nano (10^{-9})	G	giga (10^{9})
p	pico (10^{-12})	T	tera (10^{12})

COMMON CONVERSIONS

0.30480 m = 1 ft
25.4 mm = 1 in
0.4535924 kg = 1 lb
0.06479891g = 1gr
0.9463529 L = 1 qt
3600000 J = 1 kW·hr
psi = mm of Hg x (1.9339×10^{-2})
mm of Hg = psi x 51.71
4.448222 N = 1 lbf
1.355818 J = 1 ft·lbf
0.1129848 N m = 1 lbf·in
14.59390 N/m = 1 lbf/ft
6894.757 Pa = 1 lbf/in^2
1.609344 km/h = 1 mph

Temperature: $T_{°C} = (T_{°F} - 32) \times 5/9$

Temperature: $T_{°F} = (T_{°C} \times 9/5) + 32$

ABOUT THIS GUIDE

The National Institute of Justice is the focal point for providing support to State and local law enforcement agencies in the development of counterterrorism technology and standards, including technological needs for chemical and biological defense. In recognizing the needs of State and local emergency first responders, the Office of Law Enforcement Standards (OLES) at the National Institute of Standards and Technology (NIST), supported by the National Institute of Justice (NIJ), the Technical Support Working Group (TSWG), the U.S. Army Soldier and Biological Chemical Command, and the Interagency Board for Equipment Standardization and Interoperability (IAB), is developing chemical and biological defense equipment guides. These guides will focus on chemical and biological equipment in areas of detection, personal protection, decontamination, and communication. This guide focuses specifically on communication equipment and was developed to assist the emergency first responder community in the evaluation and purchase of communication equipment that can be used in conjunction with chemical and biological protective clothing and respiratory equipment.

The long range plans include these goals: (1) subject existing communication equipment to laboratory testing and evaluation against a specified protocol, and (2) conduct research leading to the development of a series of documents, including national standards, user guides, and technical reports. It is anticipated that the testing, evaluation, and research processes will take several years to complete; therefore, the National Institute of Justice has developed this initial guide for the emergency first responder community to facilitate their evaluation and purchase of communication equipment.

In conjunction with this program, additional guides, as well as other documents, are being issued in the areas of chemical agent and toxic industrial material detection equipment, biological agent detection equipment, decontamination equipment, and personal protective equipment.

The information contained in this guide has been obtained primarily through literature searches and market surveys. The vendors were contacted during the preparation of this guide to ensure data accuracy. In addition, the information contains test data obtained from other sources (e.g., Department of Defense) if available. It should be noted that the purpose of this guide is not to make recommendations about which equipment should be purchased, but to provide to the reader with information available from vendors so commercially available equipment can be compared and contrasted. *Reference herein to any specific commercial products, processes, or services by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government. The information and statements contained in this guide shall not be used for the purposes of advertising, nor to imply the endorsement or recommendation of the United States Government.*

With respect to information provided in this guide, neither the United States Government nor any of its employees make any warranty, expressed or implied, including but not limited to the warranties of merchantability and fitness for a particular purpose. Further, neither the United States Government nor any of its employees assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed.

Technical comments, suggestions, and product updates are encouraged from interested parties. They may be addressed to the Office of Law Enforcement Standards, National Institute of Standards and Technology, 100 Bureau Drive, Stop 8102, Gaithersburg, MD 20899–8102. It is anticipated that this guide will be updated periodically.

Questions relating to the specific devices included in this document should be addressed directly to the proponent agencies or the equipment manufacturers. Contact information for each equipment item included in this guide can be found in Volume II.

1. INTRODUCTION

This guide includes information that is intended to assist the emergency first responder community in the evaluation and purchase of communication equipment that can be used in conjunction with chemical and biological protective clothing and respiratory equipment. It includes a market survey of communication technologies and commercially available equipment known to the authors as of February 2001. Brief technical discussions are presented that consider the principles of operation of several pieces of equipment. These may be ignored by readers who find them too technical, while those wanting additional information can obtain it from the list of references that is included in appendix B.

The primary purpose of this guide is to provide emergency first responders with information that should aid them in the evaluation and purchase of communication equipment that can be used in conjunction with chemical and biological protective clothing and respiratory equipment. The guide is more practical than technical and provides information on a variety of factors that can be considered when purchasing communication equipment, including secure communications compatibility, line of sight (how far transmission can travel), and digital communications compatibility, to name a few.

Due to the large number of communication equipment items identified in this guide, the guide is separated into two volumes. Volume I represents the actual guide, and Volume II serves as a supplement to Volume I since it contains the communication equipment data sheets only.

Readers who find this material too technical can omit this information while still making use of the rest of the guide, and readers who desire more technical detail can obtain it from the references listed in appendix B and the data sheets provided in Volume II. Volume I is divided into several sections. Section 2 provides an overview of communication systems. Specifically, it discusses system technologies, equipment types, accessories, and enhancements. Section 3 discusses various characteristics and performance parameters that are used to evaluate communication equipment in this guide. These characteristics and performance parameters are referred to as selection factors in the remainder of this guide. Fourteen selection factors have been identified. These factors were compiled by a panel of scientists and engineers who have multiple years of experience with communication equipment, domestic preparedness, and identification of emergency first responder needs. The factors have also been shared with the emergency responder community to get their thoughts and comments. Section 4 presents several tables that allow the reader to use the 14 selection factors to compare and contrast the different communication equipment.

Three appendices are also included within this guide. Appendix A lists questions that could assist emergency first responders when selecting communication equipment. Appendix B lists the documents that were referenced in this guide. Appendix C contains information about communication equipment safety.