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A POTENTIAL FIELD EXPEDIENT TEST FOR FACE MASK INTEGRITY

by P. N. Krishnan, Ph.D.

COPPIN STATE COLLEGE
Baltimore, MD

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RESEARCH DIRECTORATE

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A study was conducted to determine the feasibility of developing a field expedient method to test the integrity of a face mask. Cursory observation indicates that tobacco smoke odor can provide a protection factor on the order of 3000 which represents a potentially significant improvement over the protection factor provided by isoamyl acetate (banana oil), which is of the order 500 or less.

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18. SUBJECT TERMS (continued)

isoamyl acetate,
negative pressure test,
field trials,
Breathing devices,
protective equipment,
test methods

PREFACE

The work described in this report was authorized under Project No. 1L162706A553, Standardization. This work was started in June 1986 and completed in August 1986.

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CONTENTS

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A POTENTIAL FIELD EXPEDIENT TEST FOR FACE MASK INTEGRITY

1. INTRODUCTION

In the battlefield situation, soldiers must don their protective masks when a chemical or biological threat is suspected (Figure 1). Once the soldier has donned his mask, proper fit is essential for maximum respiratory, eye, and skin protection in contaminated environments. Therefore, the assurance of proper fit after mask donning is of primary importance. In the laboratory evaluation of the protective masks, the leakage of a challenge aerosol is quantitatively measured using very sensitive detection instrumentation. The protection offered by a mask is usually expressed in terms of the Protection Factor (PF) which is defined as:

$$PF = \frac{Ca}{Cs} \qquad (1)$$

where:

PF = the protection factor,

Ca = the ambient challenge concentration, and

Cs = the concentration of the challenge that has penetrated inside the mask.

Cs should be very small compared to Ca; and hence, the PF must be large to assure proper protection for soldiers in the field.

The present methods used in the battlefield to evaluate the mask integrity are the negative pressure method and the challenge vapor method (coversation with CPT Charles Bass, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1986). To implement the negative pressure test, the soldier dons the mask and covers the inlet opening of the canister with his/her palm. The soldier then inhales, causing the mask to collapse slightly (negative pressure). If the mask remains collapsed while the soldier holds his/her breath for approximately 10 sec, then no leakage is apparent; and the fit is considered good.[1-4] This test is carried out during inhalation when leakage would normally occur. However, the negative pressure test is highly subjective. The test is not completely reliable as it tends to seat the mask against the face, thereby minimizing leakage potential.[5] For the challenge atmosphere technique, the standard military challenge vapor liquid is isoamyl acetate, commonly known as banana oil. A few drops of this chemical are poured on a piece of cotton or cloth and passed gently around the perimeter of the mask (Figure 2) while breathing normally. The smell of banana odor inside the mask would indicate leakage.[6] The mask would then be refitted.

The banana oil test, even though somewhat less subjective than the negative pressure test, lacks convenience in a field situation. The banana oil test offers a protection factor of approximately [illegible] (conversation with Mr. R. F. Hughes, CRDEC, 1986).[7] A much higher protection factor (of the order of 10,000) is desirable to insure maximum field protection.

Figure 1. XM40 Mask, C-2 Canister and Hood

Figure 2. Face Mask Periphery: A Potential Source for Leakage

Therefore, there is a need to develop a highly sensitive, reliable, and rapid field method to test the integrity of the face mask.

The ideal qualitative field fit test should have the following characteristics:

- Test material must be readily available.
- Detection should be easy.
- Detection at very low concentrations.
- Test material must be nontoxic and nonhazardous.
- Tests can be performed quickly.
- Test does not require special equipment.
- Test can be conducted without additional training or technical knowledge.

The present study was initiated to evaluate how well tobacco smoke satisfies the requirements of a field expedient challenge. The initial findings of this study are presented in this report.

An extensive literature survey was conducted during this study, and the important findings are discussed in the following section. This follows a discussion of a qualitative estimation of the threshold detection value of tobacco smoke odor and an estimation of the magnitude of the PF offered by this new challenge. The report concludes with suggestions for continuation of this work. An extensive bibliography is included.

2. LITERATURE SURVEY

Tobacco smoke is a highly concentrated aerosol consisting of several thousand compounds.[8-14] The smoke that enters the smoker's mouth is the mainstream smoke. Sidestream smoke is emitted directly to the ambient air from the burning end of the cigarette. Mainstream smoke and sidestream smoke consist of a particulate phase and a vapor phase.

The emission factors per cigarette for a number of these substances are given in Table 1. The aerosol concentration in tobacco smoke varies between 10^8 to 10^9 particles/cm^3.[16] The size distribution of particles was investigated extensively in the past;[16-18] particle size in tobacco smoke ranges between 0.1 μm and 1 μm (Figure 3), which is the ideal range for maximum penetration for the mask leakage studies.[19]

The odor producing components of tobacco smoke were examined in several recent investigations.[20-22] Yaglow and Witheridge[21] noted that in a ventilated room, long after the cigarette was extinguished and the visible smoke cleared the air, the odor level remained high. Additionally, removal of more than 90% of the particulate matter by filtration and electrostatic precipitation did not have any noticeable effect on the odor of tobacco smoke in a test chamber.[22] These test results indicate that gaseous components of tobacco smoke are primarily responsible for the sensory impact. It is possible to simulate tobacco smoke odor by combining 32 of the 5,000 components present in cigarette smoke (conversation with Dr. Daniel B. Kurtz, R. J Reynolds Company, 1986).[20]

Table 1. Emission Factors for Mainstream and Sidestream Smoke[15]

	Mainstream µg/cigarette	Sidestream µg/cigarette
PARTICULATE PHASE		
Total suspended particulate matter	36,200	25,800
Tar (chloroform extract)	<500-29,000	44,100
Nicotine	100-2500	2700-6750
Total phenols	228	603
Pyrene	50-200	180-420
Benzo( )pyrene	20-40	68-136
Naphthalene	2.8	40
Methylnaphthalene	2.2	60
Aniline	0.36	10.8
Cadmium	0.13	0.45
Nickel	0.08	---
Arsenic	0.012	---
2-Naphthylamine	0.002-0.028	0.08
GASES AND VAPORS		
Carbon Monoxide	1000-20,000	25,000-50,000
Carbon dioxide	20,000-60,000	160,000-480,000
Acetaldehyde	18-1400	40-3100
Hydrogen cyanide	430	110
Methylchloride	650	1,1300
Acetone	100-600	250-1500
Ammonia	10-150	980-150,000
Pyridine	9-93	90-930
Acrolein	25-140	55-300
Nitric oxide	10-570	2300
Nitrogen dioxide	0.5-30	625
Formaldehyde	20-90	1300

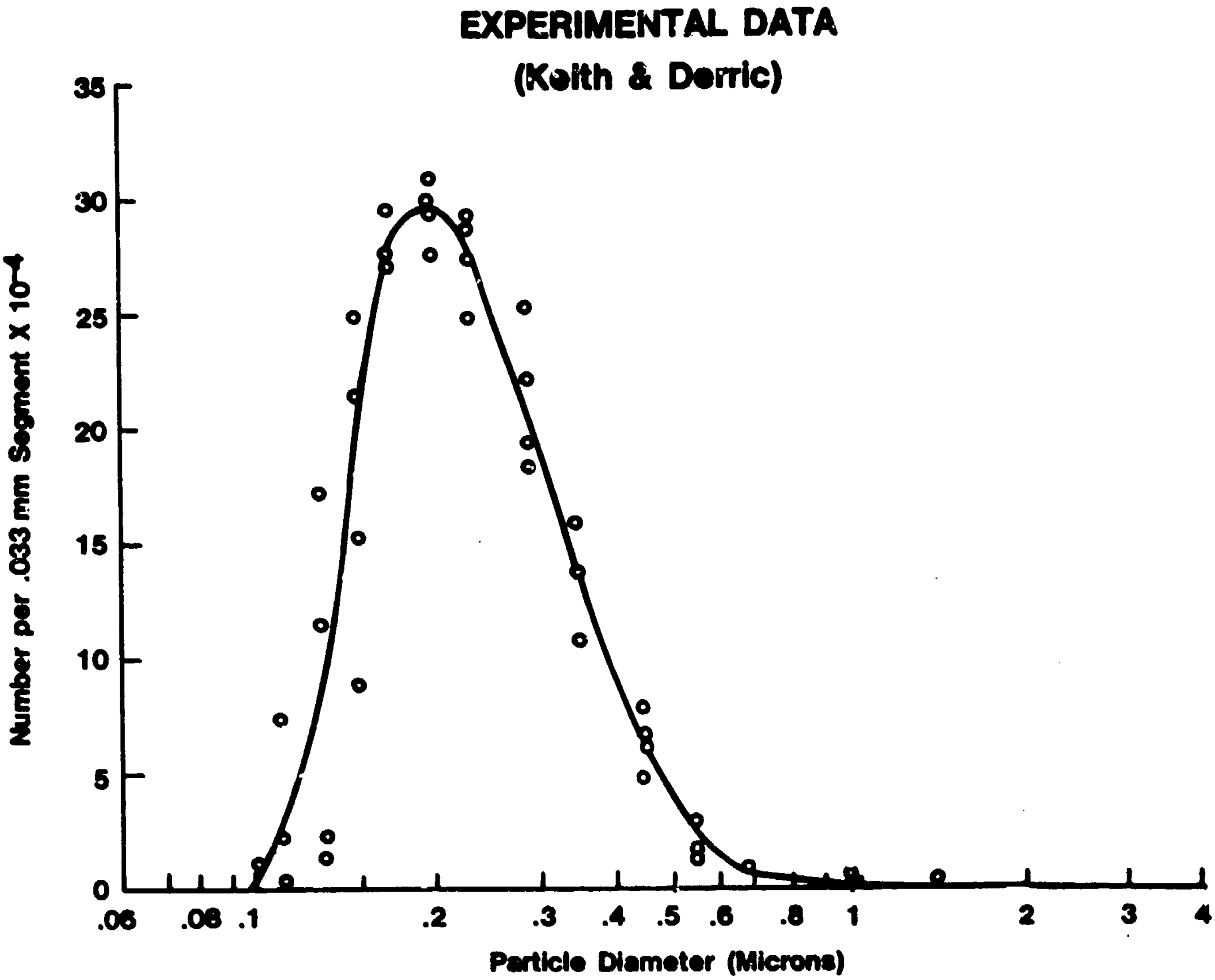

Figure 3. Particle Size Distribution in Cigarette Smoke17

The question as to whether cigarette smokers have a lesser olfactory sensitivity when compared to nonsmokers is not yet settled. However, most of the available data indicate that cigarette smoking can have an effect on olfaction.[23,24] The exact nature and extent of this effect is not clearly understood at the present time.

From the literature survey and discussions with experts in the areas of tobacco smoke research and olfactory measurements (Bibliography), the human nose appears to be exceedingly sensitive to tobacco smoke odor. Although no absolute number is available on the odor threshold concentration of cigarette smoke, this value appears to be part per billion (ppb) [volume-to-volume ratio (vv)] or lower. Furthermore, researchers do not know which compounds in tobacco smoke are responsible for the odor. Tobacco odor is a complex mixture of many odor-producing compounds. Devising a simple instrumental test to monitor tobacco smoke odor inside the mask in battlefield situations would be extremely difficult. Thus, an olfactory measurement (i.e., odor sensing) is an attractive alternative.

3. ESTIMATION OF THE PROTECTION FACTOR

Due to the the U. S. Army policy on smoking and the use of human subjects for testing no experiments were performed on humans to measure the olfactory sensitivity to tobacco smoke odor. The estimations of the detection threshold and PF were from cursory observations.

One of the authors observed a standard mask leakage test, using isoamyl acetate (banana oil) for olfactory detection of the leak. The person wearing the mask was unable to detect the odor of banana oil and reported a "tight fit". Another person, holding a lit cigarette, approached the test site. The person wearing the mask reported that he could detect tobacco odor. After tightening the mask, that person reported that he could no longer detect the odor of tobacco smoke.

Prior to the project's initiation, while the principal author was in his office, a student holding a lit cigarette entered and stayed in the room for approximately 1 min. After the student left, several other people entering the office said that they could smell cigarette smoke. The office room had a volume of 72 m^3. Assuming that the average molecular mass of cigarette smoke is 400 and also assuming that tobacco smoke is a gas, we can make a rough calculation on the olfactory threshold.

A cigarette weighs approximately 1 g and takes about 10 min to smoke. Therefore, in 1-min, approximately 1/10 g or 100 mg of tobacco has been burned and converted into gaseous form. The concentration of the smoke in the room is therefore 100 mg/72 m^3 or 1.4×10^{-3} g/m^3. The approximate value of molecular weight is 400 for tobacco smoke. We can say that 1 mole or 400 g will have 22,400 cm^3 at standard conditions of temperature and pressure. Using this relationship, we find that 1.4×10^{-3} g of smoke = 7.8×10^{-2} cm^3. We have, therefore, 7.8×10^{-2} cm^3/m^3 = 0.1 cm^3/m^3 or 0.1 ppm (same as 100 ppb). This is the magnitude of smoke odor that was detected by the students in the office. Dr. Dan Kurtz of R. J. Reynolds Tobacco Company recently pointed out that 0.1 ppm may be high, and the actual odor threshold might be much lower than 0.1 ppm for tobacco smoke.

Next, we calculate the ambient smoke concentration that can be produced within the hood volume (Figure 1) with one puff of cigarette smoke. The literature search revealed that the volume of one puff is approximately 35 cm^3, and that it contains about 5 mg of smoke.[25] Thus, the concentration of the smoke before dilution with air would be 5 mg/35 cm^3 or 0.14 mg/cm^3. Assuming that a 1:10 dilution took place inside the hood volume, the smoke concentration inside the hood would be 0.01 mg/cm^3. This is equivalent to 10 g/m^3. Assuming the smoke mixes with air completely and the mixture is in gaseous form, we can convert grams per cubic meters to parts per million as shown before. This conversion yields a value of 560 ppm. Reducing this by a factor of 2 to allow for our various assumptions, the concentration of smoke inside the hood with one puff would be about 3×10^2 ppm.

The PF, using the hood to contain the challenge, can be estimated by taking the ratio of the ambient concentration to the minimum detectable smoke concentration inside the mask.

$$PF = \frac{3 \times 10}{10^{-1}} = 3 \times 10^3 \tag{2}$$

If the tobacco odor threshold is actually much lower than 10^{-1} ppm (as suggested by experts in the tobacco research field) and if one could admit more than one puff volume of tobacco smoke inside the hood volume, then the PF could be still higher. In comparison, a PF of 300 or less can be detected with isoamyl acetate (conversation with F. P. Hughes, CRDEC, 1986). Thus, at least an order of magnitude of improvement (i.e., a PF of 3000) can be obtained by using tobacco smoke.

The findings of this study were presented to the CRDEC Senior NCO Advisory Committee. The comments of the committee are included in the Appendix.

4. CONCLUSIONS

Calculations given above are not based on any quantitative data; however, they are instructive. Note that a relatively high concentration of tobacco smoke can be produced under the hood easily and rapidly. The high concentration of tabacco smoke coupled with the low required detection levels for tobacco smoke, affords identification of extremely small leaks and suggests a high PF for the soldier. All of this combined with the ready availability of tobacco products in the field, makes tobacco smoke a potentially good field expedient challenge for testing the integrity of the face mask after donning.

Tobacco smoke offers all the characteristics required for an ideal field expedient challenge. Therefore, this concept merits further investigation.

The Department of Defense (DoD) recently issued a directive related to health promotion, which establishes policy on smoking in DoD occupied buildings and facilities.[27] Our ideas are not in conflict with this directive. In fact, both the directive and the concepts pursued here address the improvement and protection of health. Presently, examination of the potential use of cigarette smoke in testing face mask integrity is meant for field expedient situations and only for the short-term while alternatives evolve from research and development.

5. RECOMMENDATION

Previous discussions indicate the possibility of developing a methodology of testing face mask integrity by human sensory perception (e.g., smell). At the final stages of writing this report, we learned that the 3-M Company of Minneapolis, MN, filed a patent application for using a spray of aqueous solution of Sacharin for testing face mask integrity. Presently, no further information is available. This methodology can, potentially, provide the soldier with better chances of surviving on the chemical battlefield. We recommend that further studies be conducted to develop a standard test method to test face mask integrity. Such a study should be conducted in two phases:

- Phase 1: Determine the PF that can be obtained by using tobacco smoke odor. In this study, regular smokers and nonsmokers should be tested to assertain whether there is a difference in olfactory perception between these groups.

- Phase 2: If Phase 1 indicates that significantly increased PF can be achieved by this methodology, developed a Standing Operation Procedure (SOP) to conduct this test in the field.

A human use protocol is being prepared and will be submitted for approval.

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LITERATURE CITED

1. Mask, Chemical-Biological, Field Operator's Manual, TM 3-4240-279-10.

2. White, J. M., Protective Equipment, Paper presented at the First Canadian Conference, Toronto, Ontario, AECL-6175, January 23-25, 1978.

3. Pritchard, J. A, "A Guide To Industrial Respiratory," NIOSH. Vol. 76, p 189 (June 1976).

4. White, J. M., and R. J. Beal, "The Measurement of Leakage of Respirators," Am. Ind. Hyg. Assoc. J. Vol. 27, p 239 (1966).

5. Burgess, W. A., and Held, B., "Field Testing for Respirators," Ind. Safety News, September (1969).

6. Mask, Chemical-Biological, Field Organization Manual, TM-3-4240-279-20.

7. Guerin, M. R., Banbury Report 3: A Safe Cigarette, (Gori, G. B., and Bock, F. G., Eds.) New York (1980).

8. Holtzer, G., Oro, J., and Bertsch, W., "Gas Chromatographic-Mass Spectrometric Evaluating of Exhaled Tobacco Smoke," J. Chromatogr. of Sci. Vol. 126, p 771 (1976).

9. Johnstone, R. A. W., and Plimmer, J. R., "The Chemical Constituents of Tobacco and Tobacco Smoke," Chem. Rev. Vol. 59, p 885 (1959) (film).

10. Schumacher, J. N., Green, C. R., Best, F. W., and Newell, M. P., "Smoke Composition - Extensive Investigation of Water - Soluble Portion of Cigarette - Smoke," J. Agric. Food Chem. Vol. 126, p 771 (1976).

11. Wyder, E. L., Hoffman, D. J., Tobacco and Tobacco Smoke: Studies in Experimental Carcinogenesis," Academic Press, New York, (1967).

12. Brunnemann, K. D., and Hoffman, D. J., "Chemical Studies on Tobacco Smoke XXXIV. Gas Chromatographic Determination of Amonia On Cigarette and Cigarette Smoke," J. of Chromatogr. Sci. Vol. 13, p 159 (1975) (film)

13. Hoffman, D., and Wynder, E. L., The Chemistry of Tobacco Smoke, Plenum Press, New York, (1972).

14. Wadden, R. A., and Schef, P. A., Indoor Air Pollution, John Wiley and Sons, (p 147), New York, 1983.

15. Hinds, W. C., Am. Ind. Hyg. Assoc. J. Vol. 39, p 48 (1978).

16. Keith, C. H., and Derrick, J. C., "A Measurement of the Particle Size Distribution and Concentration of Cigarette Smoke By The "Conifuge"," Vol. 15, p 340, (1960) (film).

17. Langer, G., and Fisher, M. A., "Concentration and Particle Size of Cigarette Smoke Particle," A. M. A. Arch. Ind. Heal. Vol. 13, p 372 (1956).

18. Schmidt, E. W., and Sverdrup, Face-Mask Periphery-Leakage and Evaluation: Experimental Evaluation of Aerosol Penetration, CSL8-1, U.S. Army Armament Research and Development Command, Chemical Systems Laboratory, Aberdeen Proving Ground, MD, UNCLASSIFIED Report.

19. Dravnieks, A., O'Donnel, A., and Reilich, H. G., "Determination of Odor Components in Tobacco Smoke; Design of Mixture Stimulate Odor," ASHRAE Transactions, Vol. 81, p 200 (1975).

20. Yaglow, C. P., and Witheridge, W. N., "Venilation Requirement Part 2," ASHVE Transactions, Vol 43, p 423 (1937).

21. Cain, W. S., Isseroff, R., Leaderer, B. P., Lipsitt, E. D., Huey, R. J., Perlman, D., Bergland, L. G., and Dunn, J. D., Ventilation Requirements for Control of Occupancy Odor and Tobacco Smoke Odor: Laboratory Studies, W-7405-ENG-48, U.S. Department of Energy, Washington D.C., 1981. UNCLASSIFIED Report.

22. Venstrom, D., and Armoore, J. E., "Olfactory Threshold in Relation to Age, Sex, or Smoking," J. Food Sci., Vol. 33, p 264 (1968).

23. Joyner, R. E., Archives of Otolaryngology, Vol. 80, p 576 (1964).

24. Green, H. L., and Lane, W. R., Particulate Clouds: Dust, Smokes and Mists, (p 382), D. Van Nostrand Company, Inc., Princeton, NJ, 1964.

25. Tar, Nicotene and Carbon Monoxide of the Smoke of 207 Varieties of Cigarettes, Federal Trade Commission, Washington, D.C., February 1984.

26. Department of Defense Directive No. 1010.10, March 11, 1986, Subject: Health Promotion.

BIBLIOGRAPHY

Amoore, J. E., and Havtala, E., "Odor as an Aid to Chemical Safety: Odor Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilutions," J. Appl. Toxicol. Vol. 3 p 272 (1983).

Bokhoven, C., and Niessen, H. J., "Amounts of Oxides of Nitrogen and Carbon Monoxide in Cigarette Smoke, With and Without Inhalation," Nature, Vol. 192, p 458 (1961).

Burgess, W. A., and Shapiro, J., "Protection from the Daughter Products of Radon through the Use of a Powered Air-Purifying Respirator," Health Physics, Vol. 15, p 115 (1968).

Cain, W. S., "Sensory Attributes of Cigarette Smoking," Banbury Report #3, (Gori, G. B., and Bock, F. G., Ed.), Cold Spring Harbor Laboratory, New York (1980).

Cain, W. S., et al., "Venilation Requirements for Control of Occupancy Odor and Tobacco Smoke Odor: Laboratory Studies Final Report," John B. Pierce Foundation Laboratory, New Haven, Connecticut.

Church, D. F., and Pryor, W. A., "Free-Radical Chemistry of Cigarette Smoke and Its Toxicological Implications," Envir. Health Persp., Vol. 64, p 111 (1985).

Cyr, R. R., and Watkins, D. W., "Facepiece-to-Face Leakage Evaluation Using a Helium Leak Detection Method," J. Vac. Sci. Technol. Vol. 12(1), p 419 (1975).

Dravnieks, A., "Measurements of Odors in an Indoor Enviroment," Technical paper presented at First International Indoor Climate Symposium, Copenhagen, Denmark, (August 30-September 1, 1978).

Gerber, B. V., "Report on the 1985 International Symposium on Respirator Test Technology," (October 15-17 1985), Baltimore, Maryland.

Hoegg, U. R., "Cigarette Smoke in Closed Spaces," Envir. Health Persp., Vol. 2, p 117 (1972).

Jolliffe, R. V., "Filter Media Protection When Challenged by Dense Particulate Clouds," U.S. Army Chemical Research, Development and Engineering Center (CRDEC), (January 1977 - September 1979).

Katsuya, F., Sakaki, T., Sakuma H., and Saguwara, S., "Odor Analysis of Cigarette Butts by a Head Space Technique," Agric. Biol. Chem., Vol. 49(7), p 2177 (1985).

Macy, R., "The Study of Charcoal Adsorption and Methods of Testing Charcoals for Use in Gas Mask Canisters," EA-TR-52, Aberdeen Proving Grounds, MD.

Muramatsu, T., Weber, A., Muramatsu, S., and Akermann, F., "An Experimental Study on Irritation and Annoyance Due to Passive Smoking," Int. Arch. Occup. Environ. Health, Vol. 51, p 305 (1983).

Okada, T., and Matsunuma, K., "Determination of Particle Size Distribution and Concentration of Cigarette Smoke by a Light Scattering Method," J. Coll. Sci., Vol. 48(3), p 461 (1974).

Pistritto, J. V., and Shanty, F., "Evaluation of the Effectiveness of Gas Mask Canisters Against Chemical Threat Agents," ARCSL-SP-79004, U.S. Army Armament Research and Development Command, Aberdeen Proving Grounds, MD Chemical Systems Lab.

Resnik, W. H. Danker and F. L. Daylor, Jr., "Flavour Evaluation of Cigarette Smoke Components," Proceed. 3rd World Tobacco Scientific Congress, pp 522 533 (1963).

Rose, J. E., Zinser, M. C., Tashkin, D. P., Newcomb, R., and Ertle, A., "Subjective Response to Cigarette Smoking Following Airway Anesthetization," Addictive Behaviors, preprint available, to be published.

Ruth, J. H., "Odor Thresholds and Irritation Levels of Several Chemical Substances: A Review," Am. Ind. Hyg. Assoc. J., Vol. 47, p 142 (1986).

Sakaki, T., Sakuma H., and Sugawara, S., "Analysis of the Head Space Volatiles Using an Ether Trap," Agric. Biol. Chem, Vol. 48(11), p 2719 (1984).

Sakuma, H., Kusama, M., Munakata, S., Obsumi T., and Sugawara S., "The Distribution of Cigarette Smoke Components between Mainstream and Sidestream Smoke," Beitrage Zur Takakforschung International, Vol. 12, p 63 (1983).

White, C. J., "Human Primary Odors," Perfumer and Flavorist, Vol. 9, p 46 (1984).

APPENDIX

SENIOR NCO CRDEC ADVISORY COMMITTEE REPORT

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DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
SMCCR-PP	Senior NCO U.S. Army Chemical Research, Development and Engineering Center Advisory Committee

TO Cdr, CRDEC
ATTN: SMCCT-DC

FROM SMCCR-PP
Chairman, Senior Advisory Committee

DATE 23 March 1987
MSG Hill/de/3391

CMT 1

1. Reference CRDECR 15-8 dated 26 Jul 84, SAB.

2. Minutes of the Senior NCO CRDEC Advisory Committee Meeting of 9 March 1987 are attached (encl 1).

3. POC MSG Hill ext. 3391.

Encl
As stated

THOMAS P. HILL
MSG, USA
Chairman

CF:
Chief of Staff
Cdr, HHC, CRDEC
Advanced Systems Concepts
Detection Directorate
Physical Protection Directorate
Research Directorate
Chemical Surety Office
Munitions Directorate

APPENDIX

DA FORM 2496

MINUTES OF SENIOR NCO
U.S. Army Chemical Research, Development AND ENGINEERING CENTER
ADVISORY COMMITTEE

1. Attendees:

NAME	ORGANIZATION	EXT
MSG T. Hill	Physical Protection Directorate	3391
MSG G. Fenstamaker	Research Directorate	3005
MSG R. Dickerson	Detection Directorate	4437

2. The committee reviewed a proposal to use tobacco smoke as a method of mask fit testing (recommendations and copy of proposal attached).

THOMAS P. HILL
MSG, USA
Chairman

APPENDIX

Proposal: Use of Tobacco Smoke to Validate Mask Fit
Presented By: Dr. Poziomek
Evaluated: 9 March 1987

1. This committee has reviewed the proposal for the use of tobacco smoke to validate mask fit and believe that it is a valid concept. If adopted it should provide a readily available means of field testing that imposes almost no logistical burden.

2. The only question that the committee has is whether olfactory desensitization of smokers or others exposed to strong odors over a period of time would allow for valid testing to a desired protection factor.

3. Recommend that human use testing be done to validate this concept and that both smokers and non-smokers be included in this testing to determine any differences that may exist.

THOMAS P. HILL
MSG, USA
Chairman

APPENDIX