

Olfactory Sensitivity

—tobacco smoke vs. banana oil

On the chemical battlefield, soldiers must maintain maximum respiratory protection. Present leakage fit tests of the CB mask (negative pressure and "banana oil" smelling tests) have limited sensitivity.

To increase the chances for survivability of the soldier, a test with increased sensitivity (an ability to detect smaller leaks) is needed. We suggest a new simple field test to check the integrity of the face mask.

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

- The challenge material should be readily available.
- The challenge material should be easily detectable.
- The challenge material should not be toxic.
- The test should be performed quickly.
- The test should not require special equipment.
- The test should not require additional training or technical knowledge.

The human senses provide a ready "instrument" for a leak test. Of the three senses associated with the face (sight, smell, and taste), the olfactory sense (or smelling) is probably the most sensitive. Tobacco smoke seems to offer all the characteristics required for an ideal field expedient challenge.

On one occasion, one of the authors was observing a standard mask leakage test in which banana oil was used. The person wearing the mask was unable to detect the banana odor and reported a "tight fit." At that time another person, holding a lit cigarette, approached the test site. The person wearing the mask reported that he could smell tobacco odor.

by Dr. A. Birenzve,
director of research
US Army Chemical Research, Development,
and Engineering Center (CRDEC)
Aberdeen Proving Ground, Maryland,
with Dr. E. Poziomek,
chief of Operational Sciences Branch, CRDEC,
and P.N. Krishnan, coordinator of chemistry,
Coppin State College
Baltimore, Maryland

After further tightening of the mask that person reported that he could no longer smell the tobacco smoke. This suggests that tobacco smoke might be a more sensitive challenge material.

To explore the implication of this observation, we estimated the degree of protection that use of tobacco smoke as a test odorant could provide.

While one of the authors (non-smoker) was in his office, a person holding a lit cigarette entered and stayed in the room for approximately one minute. After that person left, several other people (some of them

smokers) entered the office within the next half hour.

They all commented that they could smell cigarette smoke in the room. Calculations based on the room's dimensions, the emission rate of smoke from the cigarette, and the human olfactory sensitivity seemed to suggest that the protection factor¹ of tobacco smoke is at least 3,000 (versus protection factor of 300² for banana oil.)

For further details on these calculations and other characteristics of tobacco smoke, the reader is referred to a Chemical Research, Development, and Engineering Center (CRDEC) technical report by the authors published in October 1987, CRDEC-TR-88012.

CRDEC is conducting studies to better evaluate the merits of using tobacco smoke as a challenge material. In these studies the olfactory perceptions of humans, wearing protective masks, to tobacco smoke and banana oil vapor will be compared.

Volunteers (smokers and non-smokers) wearing protective masks will be exposed to banana oil vapor and to tobacco smoke in a random order. Their ability to detect, recognize, and assess the relative intensity of the odor in each case will be recorded. A Human Use Protocol has been approved by the Surgeon General, Department of the Army.



Can cigarette smoke be used as a challenge material for fitting protective masks?

References

¹ Protection Factor (PF) is defined as the ratio of the concentration inside the mask to the concentration outside the mask.

² Although a precise PF that can be achieved with banana oil is not available, the value of 300 is widely quoted.