

DEVELOPMENT OF AN IMPROVED QUALITATIVE FIT TEST
USING ISOAMYL ACETATE

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ABSTRACT

An improved qualitative fit test using isoamyl acetate has been developed. Standard procedures for controlling a test atmosphere by evaporation of the isoamyl acetate in a plastic bag and screening an individual's ability to smell low levels of isoamyl acetate by producing a low concentration of the chemical in the vapor space of a jar are described. To validate the test procedures, measurements of these test concentrations were made. These measurements show that a test concentration of 150 ppm and a screening concentration of 1 ppm are reliably produced. To validate the performance of the fit test, 320 people were tested

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first by the isoamyl acetate procedure and then with quantitative fit-test equipment. Results of this study demonstrate that fit factors of 100 are obtained by people who pass the test, while fit factors of less than 100 are effectively rejected.

INTRODUCTION

Recent papers (Hardis et al., 1983, and Leidel, 1979) on qualitative fit testing have reported conflicting conclusions on the effectiveness of isoamyl acetate and irritant smoke as fit test agents. Fit testing is an important part of the process through which an employee is assigned a respirator; therefore, we must have a thorough and complete understanding of the limitations and performance of the available tests. Quantitative fit testing is an alternative which some have advocated because research on the effectiveness of existing qualitative tests has yielded uncertain results. However, the high cost of the test and equipment make quantitative fit testing unavailable to large segments of the population who use respirators. A definite need existed for an effective, standardized, well documented protocol for conducting a qualitative fit test. This paper summarizes the development of such a test by Du Pont, using isoamyl acetate.

FIT TESTING

Respirator fit testing consists of having a person don a respirator and enter an atmosphere containing the test agent; then leakage of the test agent into the facepiece is measured.

Fit-test methods are either qualitative or quantitative. Quantitative tests are objective in principle; they use instrumentation to monitor precisely the leakage of a

gas or aerosol into the respirator facepiece; they are sophisticated, expensive, and require skilled operators. In quantitative tests, compounds such as Freon® fluoro-carbon, sodium chloride, hexane, ethylene gas, diethylhexyl phthalate (DEHP), and other oils have been used as the test atmosphere.

Traditionally, test atmospheres have been qualitative in principle. The amount of leakage is not quantified; instead, we rely on a person's senses to detect the presence or absence of a test compound within the respirator facepiece. In other words, one of our senses has been substituted for the analytical equipment.

Qualitative methods and procedures are simple and inexpensive to set up and conduct. More popular test agents include isoamyl acetate, tin and titanium chlorides (SnCl_4 , TiCl_4), and saccharin. Isoamyl acetate has a low odor threshold, a distinctive banana-like odor, and low toxicity (Lehman and Flury, 1943). Both SnCl_4 and TiCl_4 hydrolyze to produce irritating fumes. Leakage of these fumes into the facepiece causes respiratory tract irritation and elicits an involuntary cough.

Our sense of taste can be used to evaluate face seal leakage. If a person breathes through his mouth while a sodium saccharin solution is atomized around the face seal, leakage will be detected by the bittersweet taste of saccharin.

VARIABLES OF FIT TESTING

The conflicting results researchers have seen in studying qualitative fit testing can be explained by the different techniques used to control the variables affecting the outcome of a fit test. Consequently, we began our study of fit testing by examining the underlying

factors that could affect the results. For both qualitative and quantitative fit testing, the outcome of the test depends on our ability to generate a reproducible or measured test atmosphere and to detect or measure leakage inside the respirator facepiece. We call these two concentrations the primary variables.

In a quantitative fit test, we use a mechanical generator and electronic instruments to produce, control, and measure the concentration of a test compound. We also use the electronic equipment to monitor the leakage of the compound into the respirator facepiece. For example, in a DEHP fit-test unit, a light-scattering photometer measures the relative concentration of the DEHP aerosol outside and inside the facepiece. The ratio of the outside to inside concentrations gives us a numerical measure of fit (ANSI Z88.2, 1980) called the fit factor (the ANSI standard uses the term "protection factor"). It is the reciprocal of the amount of leakage. For example, 5 percent leakage is equivalent to a fit factor of 20.

In a qualitative fit test, the primary variables are the generation of the test atmosphere and the detection of leakage. Until recently, the concentration of the test agent, isoamyl acetate, irritant smoke, or other particulates, was not controlled or measured. Leakage was detected by a response to odor, taste, or irritation; but the sensitivity of the person being fit was not determined or measured.

Other variables that affect the result of fit testing, but in a manner different from that of the primary variables, are called protocol variables. These variables affect the result an individual will be able to achieve above the design minimum, but they do not change the design minimum. For example, if we have a qualitative fit test with a required fit factor for passing the test of 100

(i.e., a design minimum of 100) and if we test a group of ten individuals with one size of respirator, we may find that eight would pass. When the fit is measured quantitatively, we would be able to find an average fit factor for the eight individuals. If we tested these same ten people again and allowed each to choose from six different sizes and styles the respirator they felt fit best, instead of giving them just one to wear, then all ten people would pass the qualitative fit test and a higher average fit factor would likely be found.

In addition to the selection of facepieces from an array of facepiece sizes, there are other protocol variables, including training, methods of putting on the respirator, and the test exercises. Fit-test protocols in current use pay little attention to these variables. Yet, if we optimize the effect of each variable in a positive manner, the protection an individual achieves will be maximized. We will explain what we did to control protocol variables during a discussion of our fit-test protocol.

ODOR SENSITIVITY TEST

If an isoamyl acetate test is to be successful, the person being fitted must indicate when leakage is detected. For us to interpret the result of a test, we must know that an individual can detect the odor of isoamyl acetate at a specific, low concentration.

Consider two theoretical fit tests on individuals "A" and "B". "A" has an odor threshold of 1 ppm; "B" has a threshold of 10 ppm. If we test both individuals in a 20 ppm test atmosphere, "A" would smell isoamyl acetate at 5 percent leakage or more and fail the test with a fit factor of 20 or less. "B" would smell isoamyl acetate at 50 percent leakage or more and fail the test with a fit factor of 2 or less.

Table 1. Odor-Detection Threshold Study.

Number of Individuals	Concentration Isoamyl Acetate (ppm)	Percent Noting Odor
26	10	100
41	5	100
40	1	95
40	0.3	95
40	0.06	65

We need to determine that both "A" and "B" can smell isoamyl acetate at a concentration of 1 ppm if we want to assume that both can get a fit factor of 20 or more. Using an odor test panel and dynamic dilution techniques (Dravnieks and O'Neil, 1979), we found the odor threshold of isoamyl acetate was approximately 0.3 ppm. The data from the panel are contained in Table 1. A screening test for isoamyl acetate at a concentration of about 1 ppm would successfully identify individuals who have difficulty smelling the test agent or who have had their odor sense deadened through inadvertent exposure to the chemical.

The procedure developed to test the odor sense of individuals before they are fit-tested is contained in Appendix A. A small amount of isoamyl acetate is placed in a jar with odor-free water. The isoamyl acetate equilibrates to a concentration of approximately 1 ppm in the headspace.

To determine the accuracy and reproducibility of the odor sensitivity test, we took headspace samples from replicate test solutions, using a gas-tight syringe, and

injected them directly into a gas chromatograph for analysis. Eighty-four measurements were made using five test solutions. The solutions were prepared on different days and measurements were taken throughout the day to simulate use conditions.

We found a mean concentration of 1.1 ppm with a standard deviation of 0.5 ppm. These data show that a concentration of approximately 1 ppm can be produced with adequate accuracy and reproducibility. Additional measurements demonstrate that concentration does not vary significantly with temperatures over a range of 16°C (60°F) to 32°C (90°F) as shown in Table 2.

TEST ATMOSPHERE

The concentration of isoamyl acetate during the fit test has a direct effect on the result of the test. Consider two people, "C" and "D", both with an odor threshold of 1 ppm. If "C" is tested with a test concentration of 5 ppm and "D" with a concentration of 50 ppm, then "C" will smell isoamyl acetate only when the leakage is greater than 20 percent (5 ppm test times 20 percent leakage equals odor threshold). On the other hand, "D" will smell isoamyl acetate if the leakage is greater than 2 percent.

Since fit factor is the reciprocal of leakage, "D" will smell isoamyl acetate when the fit factor is 50 or

Table 2. Odor Sensitivity Test--Effect of Temperature._____

Temperature °C (°F)	Number of Determinations	Concentration (ppm)
16 (60)	20	0.9
24 (75)	84	1.1
32 (90)	20	1.1

less, while "C" will smell it when the fit factor is 5 or less. Obviously, the level of a compound used as the challenge during the fit test must be controlled.

Appendix B contains the procedure that we developed for building a test booth. Appendix C contains the fit-test procedure that gives a stable, known test concentration. The test concentration averages 150 ppm.

The test concentration fluctuates slightly in the chamber during the fit test because of breathing and air current disturbances. The range of concentrations that could occur during any single test was estimated by reading the concentration at 20-second intervals during 16 fit tests. Test concentrations were measured with the Miran[®] analyzer. The sampling probe was placed approximately 7 to 15 cm (3 to 6 inches) in front of the person being tested. The mean concentration was 155 ppm, with a standard deviation of 35 ppm.

The concentration of isoamyl acetate in the chamber is rather insensitive to temperature. Measurements made in an environmental chamber at temperatures ranging from 16°C to 32°C (60°F to 90°F) are shown in Table 3. All measurements were made with the Miran[®] analyzer as above (Dravnieks and O'Neil, 1979).

Table 3. Challenge Test Concentration--
Effect of Temperature.

Temperature °C (°F)		Number of Determinations	Concentration (ppm)
16	(60)	85	190
24	(75)	21	155
32	(90)	5	195

VALIDATION PROCEDURE

Since we have a theoretical detection of leakage at 1 ppm and a challenge concentration of 150 ppm, individuals who pass the isoamyl acetate fit test (do not smell isoamyl acetate) have leakage of less than 1 ppm and a fit factor of approximately 150 or more (fit factor = 150 ppm challenge divided by maximum facepiece leakage of 1 ppm).

To verify that the fit test would perform as expected, 187 male employees were tested at Du Pont plants. The sequence of testing was:

- Orientation and training
- Selection of a respirator
- Odor sensitivity test
- Donning and familiarization period
- Positive and negative pressure tests
- Qualitative fit test
- Quantitative fit test.

The tests were conducted as they would be in a plant program. The object of this study was to test the performance of the whole fit testing procedure, not just the fit test.

After a qualitative fit test had been completed successfully, a quantitative fit test was run without having the facepiece disturbed. If someone failed the qualitative test, he selected another mask; the odor sensitivity test was rerun and the test sequence was continued.

The orientation, training, fitting, and donning instructions used for this study have been published by the National Paint and Coatings Association in their "Guide to Respirator Fit Testing" (1981). By using these procedures, we were attempting to control any effects the protocol variables may have had.

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The orientation program was used to explain the test procedure and to encourage the employees' active participation and cooperation.

For respirator selection, three sizes of MSA Comfo II[®], two sizes of Norton 7500, and an MSA Ultra-Twin[®] full facepiece were made available. Employees were instructed to hold each of the half-mask facepiece respirators against their face and choose for testing the one that felt as if it would fit their face most comfortably. This comfort selection process is an important part of the fitting process since a mask that is comfortable is more likely to fit properly.

The donning technique included instructions to rotate the head gently once the respirator was put on. We felt these actions would improve the face seal and reduce some of the fitting variability.

The exercises listed in the ANSI Z88.2 (1980) standard were used for both qualitative and quantitative fit tests. The quantitative tests were run on a Dynatec/Frontier FE250A, a portable fit-test unit with diethyhexyl phthalate as the test aerosol. The numerical value for each fit test was calculated by dividing the average chamber concentration by the average peak leakage. The average peak leakage was calculated by averaging the peak heights for each breathing cycle within an exercise and then average each exercise.

RESULTS AND DISCUSSION

Of the 187 males who participated in the study, 96 percent were able to pass the isoamyl acetate test with a half-mask facepiece respirator. The remaining 4 percent passed with a full facepiece respirator. All but two

of the quantitative fit factors for the 187 people exceeded 100. The two below 100 were 96 and 97. The median fit factor measured with the quantitative fit-test equipment was approximately 2000.

Statistical tests show that the distribution of the quantitative fit factors is significantly different at the 5 percent level from the normal or lognormal distributional models. To estimate performance, nonparametric procedures were employed; they show we have 95 percent confidence that 97 percent will pass the fit test with a fit factor of 100 or greater.

A supplementary fit study was conducted on a group of individuals who were not allowed to choose their own mask. In this way we were able to evaluate the performance of the fit test in rejecting relatively poor fits. Individuals in this group were quantitatively fit-tested whether they passed or failed the qualitative test. Twenty-two individuals were each fitted with three different masks. Twenty-nine fits were obtained with factors of less than 100. In each of these fits, the isoamyl acetate test was failed. The lowest factor for an individual who passed the isoamyl acetate test was 700. Results from this series of tests are contained in Table 4.

Table 4. Supplementary IAA Evaluation Using Three Sizes of Respirator per Subject.

NUMBER OF FIT TESTS	66
RANGE OF QNFF	2-4800
NUMBER OF QNFF < 100	29
NUMBER PASSING IAA TEST	15
LOWEST QNFF PASSING IAA TEST	700

Table 5. Supplementary IAA Evaluation on Bearded Subjects.

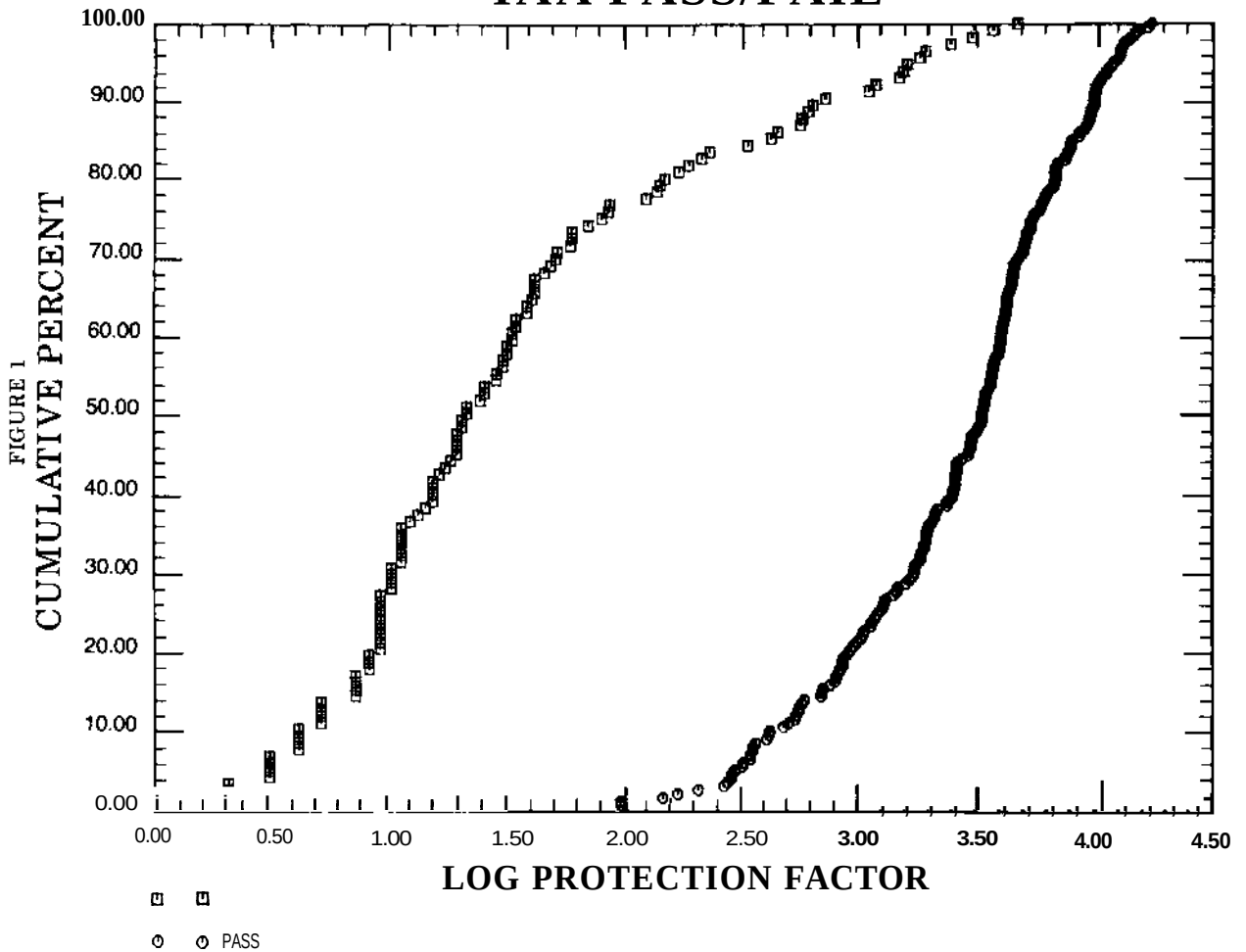
NUMBER OF SUBJECTS	67
RANGE OF QNFF	2-185
NUMBER OF QNFF <100	61
NUMBER PASSING IAA TEST	0

In an additional study on a group of bearded individuals, 61 of 67 had fit factors that measured 100 or less; none passed the isoamyl acetate test. Data are summarized in Table 5.

Both of the supplementary studies show that the isoamyl acetate fit test rejects fits of less than 100 as measured by quantitative fit testing. Figure 1 depicts a combined cumulative distribution plot for the three data sets. We see from the data that the isoamyl acetate fit test effectively segregates individuals into two groups: those with a good fit and those whose fit is unacceptable. The low cutoff point for passing the test is 100.

In the distribution of people who failed the fit test (Figure 1), approximately 20 percent had fit factors greater than 100. This result is not unexpected, nor do we consider it to be a great deficiency. Some people fail the isoamyl acetate fit test with rather high fit factors because their odor sensitivity is well below 1 ppm, as shown in Table 1. In addition, in a qualitative test, instantaneous detection of odor constitutes a failure. In the procedure for calculating quantitative fit factors according to the instructions provided by the equipment manufacturer, peak leakages are averaged.

IAA PASS/FAIL



As a practical matter, we have not found this rate of failure to be a problem. Individuals who failed with their initial mask selection were able to return and select a new mask and then pass the fit test. If a smaller number of respirator sizes were available as a selection, this rate of initial failure could lower the percentage of successful fits.

We are unable to make more exact predictions of the performance of the isoamyl acetate fit test because of uncertainties concerning the underlying distribution of quantitative fit factors; we have been unable to fit the data to a particular model such as the lognormal or normal distribution.

During testing, several phenomena were noted which may explain why we have been unable to describe the underlying distribution of fits. For example, on switching between the 1.0 percent and 0.1 percent scale settings, a 6 percent shift in scale readings was noticed. This would produce a small measurement error in some fit tests.

The filter efficiency of the respirator filter element may affect the readings. Filter efficiencies for high efficiency respirators are at least 99.97 percent. Normally, the efficiency is in the range of 99.992 percent. Aerosol leakage through the filter element would play an important role in the measured fit factor for fits with very low face seal leakage. Consider two fits, at 0.2 percent leakage and 0.02 percent leakage (fit factors of 500 and 5000, respectively). With a constant filter leakage of 0.008 percent (99.992 percent efficient), the filter leakage represents 4 percent of the total leakage at the fit factor of 500 ($0.008 \text{ percent} / 0.2 \text{ percent}$) and a substantial 40 percent of the measured leakage at a factor of 5000.

Another condition we found was that individual fit tests with leakages of less than 0.05 percent showed a gradual rise in the leakage seen during a test. In one of these cases, when the person was removed from the fit chamber without first disconnecting the respirator probe, no change in the measured fit was seen. Obviously, something other than DEHP aerosol was registering as leakage. We believe this may be moisture in the form of sputum particulate or condensation on the light-scattering measuring equipment. This phenomenon, which causes a shift toward apparent higher leakage, we call "wet breaths."

All these factors together exert influences on the data collected. Together or individually, they may explain the reason why a distributional model could not be found.

CONCLUSIONS

An improved isoamyl acetate fit test has been developed. By paying careful attention to the variables which may affect the outcome of the fit test, we have shown that qualitative testing can be used for the safe selection of respirators.

In performing a qualitative fit test, the important variables which must be controlled are the ability of the individual being tested to detect leakage and a stable, known concentration of the agent in a test atmosphere. Protocols have been written which control these two important variables.

Validation of the fit protocol shows that the isoamyl acetate protocol ensures fit factors of at least 100 and effectively rejects fit factors of approximately less than 100.

The same principles used in the development of improved isoamyl acetate fit tests have been applied by others to a qualitative fit test using irritant smoke and a saccharin mist. Procedures for these tests can be found in the OSHA lead standard 29CFR 1910.1025 (1982).

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APPENDIX A

ISOAMYL ACETATE TEST SENSITIVITY CHECK

PURPOSE

For the isoamyl acetate test to be effective, persons tested must be able to detect very low isoamyl acetate concentrations. This ability can be evaluated through the following procedure.

Repetitive measurements have demonstrated that the test jar has a concentration of 1 ppm in the head space. This has been verified over a temperature range of 60 to 90°F.

Most people can easily detect this low amount. In over 800 tests, only four people were unable to identify the correct jar: three individuals with severe colds and one individual with a permanent loss of the olfactory sense.

MATERIALS

- Two medicine droppers with 0.5 and 1 cc markings. (These can be made up, purchased at a drugstore,

or often can be found in liquid vitamin or liquid aspirin bottles.)

- Isoamyl acetate, also known as isopentyl acetate. (This can be purchased from chemical laboratory supply houses.)
- Odor-free water (approximately 25°C)--e.g., distilled or spring water. (This can be purchased at a supermarket.)
- Three 1-quart glass canning jars with lids. (These are volumetrically graduated and are available at supermarkets.)

PROCEDURE

The preparation of the isoamyl acetate test jars should not take place in the room where the sensitivity check will be conducted. Only the test and control jars should be taken to the sensitivity check area. Squir 1 cc of full-strength isoamyl acetate into a jar containing 800 cc odor-free water. Screw on the lid and shake the contents of this stock solution for one-half minute. This mixture is good as stock solution for one week. Remove lid and, with another dropper, extract 0.5 cc of isoamyl acetate-water mixture and squirt it into a second jar containing 500 cc odor-free water. Immediately screw on lid and shake the contents for one-half minute. Allow the mixture to stand undisturbed for two to three minutes to allow the isoamyl acetate concentration above the liquid to reach equilibrium. This solution is good for a full day's use. Pour 500 cc water into a third jar (control). The second and third jars will serve as test jars. Label the jars 1 and 2 for easy identification. Apply the labels to the lids of the jars and periodically dry the insides of the lids and switch the lids to avoid creating the impression that the same jar always contains the isoamyl acetate.

Without indicating which jar contains isoamyl acetate, ask the person to shake each bottle, then remove the lid and identify the jar having the odor of isoamyl acetate. The following directions can be typed on a 5 inch by 7 inch index card to standardize this test:

"The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tightly, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the instructor which bottle contains banana oil."

If the person smells isoamyl acetate in the correct jar, proceed with the isoamyl acetate qualitative fit test. If no odor or an odor in more than one jar is detected, prepare a stronger mixture by extracting 1 cc from the stock mixture and squirting it into a jar containing 500 cc water. Again, prepare a control. If isoamyl acetate is detected in the correct jar, proceed with the isoamyl acetate qualitative fit test. The person should be told that this is the level of odor perception that may be experienced inside the respirator when the fit test is being conducted.

If no odor, or an odor in more than one jar is detected, the person cannot reliably smell isoamyl acetate and will need to be tested with the sweetener aerosol procedure or another method. Caution should be exercised before assigning anyone to use a respirator who cannot smell the isoamyl acetate since odor-detection may be needed to determine the end of cartridge life. The ability of an individual to smell the contaminant should be confirmed before assignment.

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Remember:

- The mixtures used in the isoamyl acetate odor detection test must be prepared in an area separate from where the test is performed. This separation will prevent olfactory fatigue, which renders a subject unable to detect the odor of isoamyl acetate. Fatigue can occur at very low background levels.
- To achieve proper results, the jars should be tightly covered and shaken well before each use.

APPENDIX B

TEST CHAMBER DESIGN

PURPOSE

A simple, inexpensive chamber was designed to facilitate respirator-fit testing. The components can be easily purchased and assembled.

MATERIALS

- A clear polyethylene bag approximately 24 inches in diameter and 60 inches long (e.g., a 55-gallon drum liner).
- A 24-inch diameter disk cut from 1/4-inch plywood or heavy cardboard.
- A 1/4-inch diameter eyebolt approximately 2 inches long with two nuts and washers.
- A two-inch thread screw hook.

ASSEMBLY

1. Drill a 1/4-inch diameter hole at the center of the disk.

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2. Screw one nut well up the eyebolt stem, slide one washer up to the nut, and insert assembly through the disk. Slide the second washer over stem and tighten the second nut.
3. Place the screw hook into the disk as close to the center as possible on the side opposite the eyebolt.
4. Hold the polyethylene bag with the open end pointed down and slide the disk (with eyebolt pointed upward) up through the bag towards the closed end. The plywood disk becomes the chamber ceiling.
5. Make a small hole in the top of the bag for the eyebolt to go through. Suspend the bag from the eyebolt so the chamber ceiling is about 7 feet from the floor.
6. To allow for variation in individual heights, the cord suspending the chamber can be run through an "O" ring on the ceiling. If the cord is then anchored at some convenient location, a slip knot can be used to adjust the chamber height. The chamber should be adjusted so the chamber ceiling is 6 inches above the top of the subject's head.

The unit is now ready for use as a respirator fit test chamber for isoamyl acetate.

APPENDIX C

ISOAMYL ACETATE QUALITATIVE FIT TEST

PURPOSE

The following procedure assures that a concentration averaging 150 ppm is maintained during the test. This test is effective over a temperature range of 60 to 90°F.

This procedure should be followed to conduct a qualitative fit test using isoamyl acetate. Only those people who have passed the isoamyl acetate sensitivity check should be tested by this method. Studies indicate that when this method is followed, people passing the test are using respirators that give protection in excess of the maximum use units allowed by OSHA regulations.

PREPARATION

The following items are needed:

- A test chamber.
- Isoamyl acetate, also known as isopentyl acetate, technical grade--95% pure or better.
- A 1/2 cc eye dropper, which may be obtained from a drugstore or in children's liquid vitamin or liquid aspirin bottles.
- A test area with good ventilation, separate from areas where the isoamyl acetate sensitivity test and mask selection are done.
- Appropriate organic vapor respirators. The cartridges are color-coded black and should be changed at least weekly.
- A paper towel or other porous, absorbent, single-ply material cut approximately 4 inches by 5 inches and folded in half.
- Any respirator manufacturer's cleaner-sanitizer or non-alcoholic antiseptic towelettes. These will be used to wipe down the respirator between test subjects.

PROCEDURE

1. Before beginning this test, the person should have completed the isoamyl acetate sensitivity test and the facepiece selection process.
2. It is important to minimize the person's exposure to isoamyl acetate to prevent olfactory sense fatigue.

The odor test, selection, and donning of the mask should occur in one room. The test chamber should be located in another room or should be in such a well-ventilated area that general room contamination is prevented.

3. Before the person is taken to the test chamber, check the respirator to be certain it has organic vapor cartridges. The individual should put on the respirator, adjust the straps, and "seat" the mask by moving the head rapidly from side to side, up and down, and taking a few deep breaths. Conduct the positive- or negative-pressure test. Take the person, with the respirator on, to the fit-test chamber.
4. When the person has entered the test chamber, adjust the height to six inches above the head. Take the piece of absorbent paper, fold in half, and using the calibrated eyedropper, apply 1/2 cc full-strength isoamyl acetate. Hand the towel to the person, who should hang the folded saturated towel from the screw hook provided in the center of the chamber ceiling.
5. Allow two minutes for the isoamyl acetate test concentrations to be reached before starting the fit-test exercises. It would be appropriate to use this time to talk with the subject, to explain the fit test, the importance of cooperation, and the purpose of the head exercises or to demonstrate some of the exercises.
6. If at any time during the test the individual detects the banana-like odor of isoamyl acetate, he/she should quickly exit the test chamber and leave the test area to avoid olfactory fatigue.
7. Upon returning to the selection room, the person should remove the respirator, repeat the odor sensitivity test, select and don another respirator, and repeat the qualitative test. The process continues until a respirator that doesn't leak has been found. Should the individual fail the odor sensitivity test, he/she

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should wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

8. If a person cannot be fitted with the selection of half-mask respirators, include full facepiece models in the selection process.
9. When the test is complete, to keep the area from becoming contaminated, place the used towel in a self-sealing bag. There is no significant isoamyl acetate concentration buildup in the test chamber from repeated tests.

NOTE: Some users of this method find that after a person passes the test, a dramatic demonstration of the respirator's effectiveness is very beneficial. Simply have the person break the seal of the respirator by placing a finger through the sealing surface. The immediate exposure to 150 ppm of isoamyl acetate is very convincing.

As an alternative, some find that a recheck of odor sensitivity can be used as an honesty screen. If a person has had significant leakage and failed to report it for some reason, he/she will not be able to detect the 1 ppm of isoamyl acetate in the sensitivity check due to odor fatigue. Having the person repeat the sensitivity check with a different set of bottles can be very effective.

The exposure that occurs during the fit test to isoamyl acetate is considered to be minimal. Some individuals may experience eye irritation during the test. During the initial two-minute-stabilization period, the possibility of eye irritation should be mentioned, along with assurances that the irritation, if it occurs, is transient and not harmful.