II Explanation of the Environment Agency Notification, "Determination of odor index and odor emission rate"

Chapter 1 Panel

1. Standard odor solutions

No. 1 Panel

The panel (a group of persons who judge the presence of odor with their olfaction, hereinafter called the “panel”) is a group of persons recognized to have normal olfaction by the panel screening method in 2 using the standard odor solutions in 1.

1 Standard odor solutions

Five standard odor solutions are listed below.

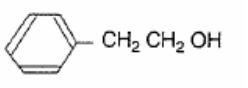
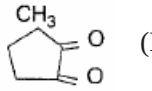
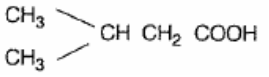
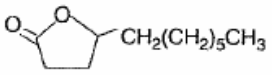
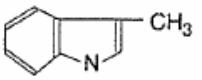
β-Phenylethyl alcohol	$10^{-4.0}$
Methyl cyclopentenolone	$10^{-4.5}$
Isovaleric acid	$10^{-5.0}$
γ-Undecalactone	$10^{-4.5}$
Skatole (3-Methyl indole)	$10^{-5.0}$

* The column on the right indicates the ratio of the solution’s weight to odor-free liquid paraffin.

The panel (a group of persons recognized to have normal olfaction in the triangular odor bag method) sniffs the air in odor bags (three bags delivered as one set), and judges for the presence of odor. Therefore, an especially excellent olfactory acuity is not necessary, but it is essential to have the sensitivity of an average person. Because of this, it is necessary to test for normal olfaction by using the following panel screening method. Standard odor solutions are used in this panel screening method.

These five substances were selected as standard odor solutions through studies, such as the offensive odor investigation method study meeting of the Environment Agency starting in the early 1970s, from 10 substances developed by Prof. Sadayuki Takagi at Gunma University (at the time) for use in the olfactory test and diagnosis, based on his researches in the late 1960s and early 1970s.

Table 1: Types of standard odor solutions and odor character

Substance name	Molecular formula	Constitutional formula	Odor character
β-Phenylethyl alcohol	$C_8H_{10}O$		- Floral smell - Smell of rose petals
Methyl cyclopentenolone	$C_6H_8O_2$	 (Diketone type)	- Sweet burning smell - Smell of pudding (burned caramel part)
Isovaleric acid	$C_5H_{10}O_2$		- Smell of sweat - Smell of stuffy socks
γ-Undecalactone	$C_{11}H_{20}O_2$		- Smell of ripe fruit - Smell of canned peaches
Skatole (3-Methyl indole)	C_9H_9N		- Musty smell - Smell of feces

The molecular formula and constitutional formula of the standard test odors are listed in Table 1. The standard odor solutions that are actually to be used for the panel screening are adjusted to a pre-determined concentration by using the same reagent as that approved for the olfactory test diagnosis, and are commercially available "standard odor solutions" for the olfaction measurement. Standard odor solutions that have expired (two years after production, one year after opening) should not be used.

Through studies, such as the offensive odor investigation method study meeting of the Environment Agency (starting from the early 1970s), the range of persons who are considered to have normal olfaction was decided based on the Japanese olfactory acuity distribution on the standard test odors as follows:

1. Based on the Oto-rhino-laryngoloical Society of Japan, persons who have normal olfaction in the sensory test of standard odors should be at least -1.0 SD (SD = standard deviation) (by using the recognition threshold*).

2. It is practical to adjust this to the olfactory acuity of the real panel members (at least -1.0 SD).

3. It is necessary to consider that there exists a variation of about 0.5 SD within individuals' olfactory acuity.

Based on these three reasons, it is appropriate to judge that a person who has olfactory acuity over -1.5 SD has normal olfaction. For reference, mean values and standard deviations of the n values in gaseous threshold concentration 10 (w/w) of five standard test odors of the T&T olfactometer are listed in Table 2.

* Recognition threshold: The lowest concentration at which the odor can be easily recognized

Table 2: Japanese olfactory acuity distribution on the standard test odors

Standard Test Odor	Mean Value of n	Standard Deviation (SD)	n Value correspond to -1.5 SD	Standard Concentration for Panel Selection (w/w)
β-Phenylethyl alcohol	5.35	0.95	3.92	$10^{-4.0}$
Methyl cyclopentenolone	5.36	0.66	4.38	$10^{-4.5}$
Isovaleric acid	6.01	0.73	4.92	$10^{-5.0}$
γ-Undecalactone	5.49	0.76	4.35	$10^{-4.5}$
Skatole (3-Methyl indole)	6.40	0.96	4.97	$10^{-5.0}$

* This is based on the total data of three institutions from the research report of Offensive Odor Evaluation Improvement Investigation Study (Environment Agency: Offensive odor evaluation improvement study meeting), 1976.

The testing institutions and the number of subjects relating to the total data are shown below.

Testing Institution	Number of Subjects for Each Standard Test Odor					Age
	A	B	C	D	E	
Japan Environmental Sanitation Center	139	212	212	110	212	20's to 40's
Tokyo Metropolitan Research Institute for Environmental Protection	16	371	371	16	371	10's to 60's
Nihon University	72	73	73	72	73	10's to 20's
Total	227	656	656	198	656	

2. Panel screening method

No. 1 Panel

2 Panel screening method

(1) A set of five strips of test paper, marked with the numbers 1 to 5 (14 cm long x 7 mm wide, hereinafter called the "smelling strip"), are prepared. The top 1 cm of any two smelling strips are soaked in a standard odor solution. The remaining three smelling strips are soaked in the odor-free liquid paraffin using the same method.

(2) A set of five smelling strips are handed to the subjects (must be at least 18 years of age), who choose the two smelling strips with odor by using their olfaction.

(3) The procedures of (1) and (2) are carried out for each of the five standard odor solutions, and it is acknowledged that a person who answers correctly for all of five has normal olfaction.

(4) It is necessary to confirm that a person maintains normal olfaction by carrying out the above test every five years (every three years for people over 40 years old).

The purpose of panel screening is to choose a person who has normal olfaction, which is required to the subject for olfactory measurement (panel). When adopting a new panel member, or confirming olfaction every five years (every three years for people over 40 years old), the test should be carried out according to the following procedures (hereinafter called the "olfactory test").
It is strongly preferred that a panel member is eager to do this work.

1) Olfactory test procedures

Five standard test odor solutions are used for the olfactory test, and olfactory acuity is tested by having each person sniff these solutions. To reduce the probability of answers being correct incidentally, the Two-out-of-Five test (a method of choosing two smelling strips out of five smelling strips) is implemented.

a) There is one operator per subject. To keep subjects from knowing the records (correct answers), a measure to separate the operator and the subject with a screen, as shown in Figure 1, should be taken.

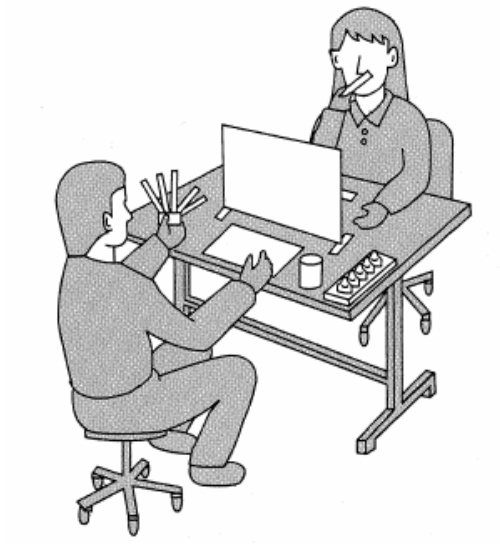
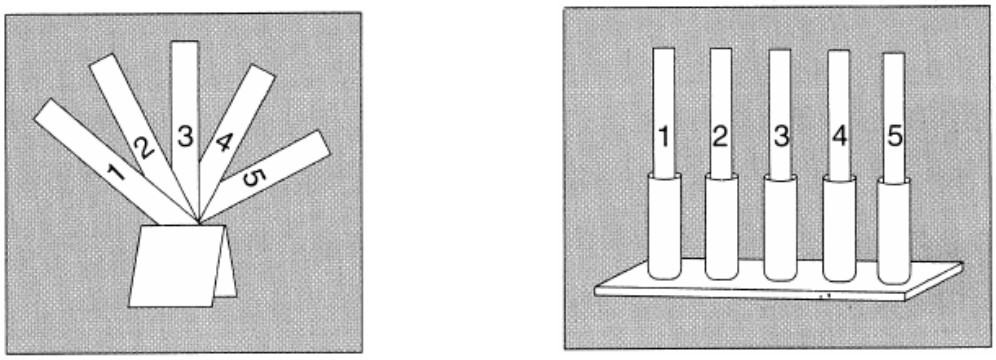


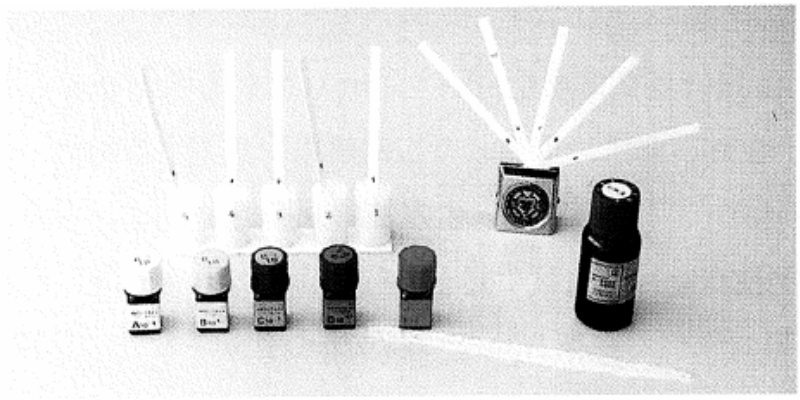
Figure 1: Implementation method of olfactory test

b) A set of five strips of test paper, marked with the numbers 1 to 5 (14 cm long x 7 mm wide, hereinafter called the "smelling strip"), are prepared. As shown in Figure 2, these smelling strips are clipped to or inserted into holders for the test.



Clip system Holder system

Figure 2: How to erect a set of test paper



(Photo demonstrating the same as the above)

c) The top 1 cm of any two smelling strips out of the above five smelling strips are soaked in one standard odor solution. The remaining three smelling strips are soaked in the odor-free liquid paraffin (commercially available odor-free liquid) in order to avoid being distinguished by sight. Be careful that any liquids do not drip in doing so.

d) A set of five smelling strips are handed to the subjects, who then sniff these smelling strips. Subjects are to sniff the smelling strips one by one, and check for the presence of odor.
Subjects sniff an odor by putting their nose close to, but not touching, the tip of a smelling strip, as shown in Figure 3. After sniffing the odor of all the smelling strips, subjects answer by giving the numbers of the two smelling strips with odor. If they cannot distinguish the odors, they can sniff the smelling strips a second time. Subjects are not to give answers verbally, but are to write their answers on the answer sheet. When clipping the smelling strips, a holding stand such as the one shown in Figure 4 should be prepared, since the odor of smelling strips that have been sniffed may be adsorbed to the desk, if placed directly on the desk.

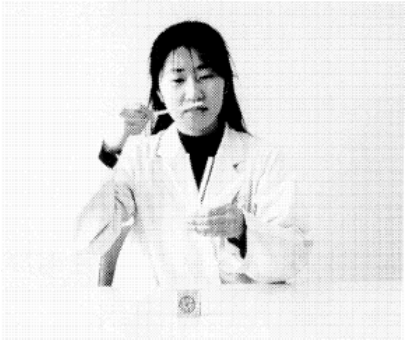


Figure 3: How to sniff a smelling strip

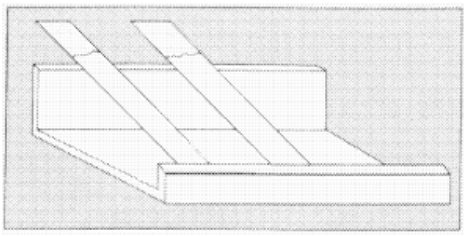


Figure 4: Holding stand for smelling strips

e) Smelling strips are to be discarded after each test. Since discarded smelling strips may leave some odors in the test room, they should be thrown away in a lidded wastebasket, or placed in a plastic bag and fastened with a rubber band before being thrown away in a wastebasket.

f) A person who answers correctly for all of the five standard odors has successfully passed the olfactory test.

2) Remark for the olfactory test

a) The requirements of the location where the olfactory tests are to be carried out are the same as those for the sensory test room to be used in the triangular odor bag method, which is described later.

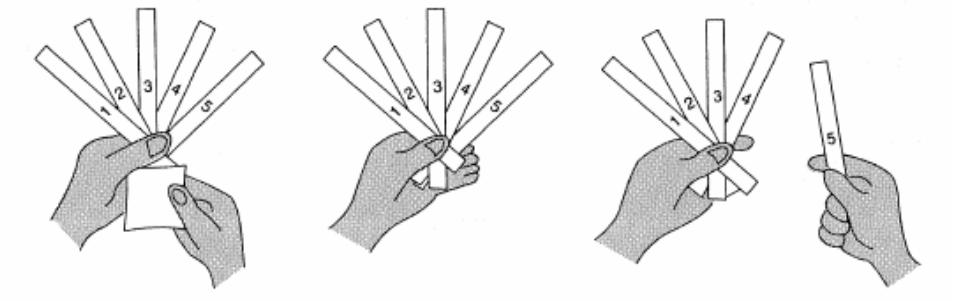
b) A person who takes the panel screening test must be 18 years old and over.

c) Instructions on taking off the clipped smelling strips are shown in Figure 5.

d) It is recommended to sniff the smelling strips as soon as possible after soaking them in the standard odor solution. It should be noted that methyl cyclopentenolone can easily evaporate and the odor adsorbed on a smelling strip can easily fade.

e) If an incorrect answer is given to only one of the five standard odor solutions, the olfactory test should be carried out twice with the standard odor solution for which the answer was incorrect. If the correct answer is given twice, the person has successfully passed the olfactory test.

f) The approximate time required for the olfactory test is usually about 10 minutes per person.



a) Hold the clip by one hand, and hold the lower part of five smelling strips with the other hand.

b) Next, remove the clip and put it on the desk.

c) Using the hand that removed the clip, take the smelling strips one by one, and sniff its odor.

Figure 5: How to take off the smelling strips

3) Managing the panel

Generally, the olfactory acuity of those who have successfully passed the olfactory test remains stable for a period of five years. Therefore, it is necessary to carry out the olfactory test every five years. It is recommended to retest any persons who are over 40 years old every three years, because their olfactory acuity tends to deteriorate. It is also necessary to perform the olfactory test on persons who are concerned about abnormalities in their olfaction, due to such factors as diseases and traffic accidents.