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Standard Guide for Odor Evaluation of Products and Materials Under Controlled Conditions With Trained Panel[1]

This standard is issued under the fixed designation E3261; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides guidelines for odor evaluation of products and materials under controlled conditions with a trained panel.

1.2 This guide addresses odor, aroma, malodor and fragrance (see Terminology E253).

1.3 This guide addresses assessor selection and training, sample preparation, and test procedures specific to odor evaluations.

1.4 This guide does not address odor of any specific category of products.

1.5 This guide does not recommend a specific testing method. The user is responsible for identifying the most appropriate test design and analysis tools to address the research questions.

1.6 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E253 Terminology Relating to Sensory Evaluation of Materials and Products

E544 Practice for Referencing Suprathreshold Odor Intensity

E619 Practice for Evaluating Foreign Odors and/or Flavors from Paper Packaging

E1593 Guide for Assessing the Efficacy of Consumer Products in Reducing the Perception of Malodor

E1885 Test Method for Sensory Analysis—Triangle Test

E2139 Test Method for Same-Different Test

E2164 Test Method for Directional Difference Test

E3000 Guide for Measuring and Tracking Performance of Assessors on a Descriptive Sensory Panel

E3009 Test Method for Sensory Analysis—Tetrad Test

E3041 Guide for Selecting and Using Scales for Sensory Evaluation

3. Terminology

3.1 See Terminology E253 for sensory evaluation terminology.

4. Summary of Guide

4.1 Odor testing has many unique requirements for sensory assessment. This guide outlines proper assessor selection, training, protocols for odor testing including sample collection and preparation, and presentation methods spanning assessments from small jars to large chambers as well as olfactometer equipment and direct sniffing. Project goals and objectives will dictate the evaluation method or methods. A complete report will outline choices made in the final project protocol.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

5. Significance and Use

5.1 This guide provides general guidelines and recommendations for presenting product and material samples to assessors for evaluation of odor attributes under controlled conditions. Specific situations may require variations to these guidelines.

5.2 This guide is designed for use in assessing odor of products and materials for such applications as, but not limited to, development, reformulation, complaint investigation, quality control, and stability/shelf-life.

5.3 Elements of this guide may also be utilized for assessor training programs involving odor evaluation tasks.

6. Facility Considerations

6.1 The testing environment must be free of noise, non-test odors, and other distractions.

6.2 All staff and assessors must be odor-free with considerations for wearing only odor-free, especially fragrance-free, personal care products.

6.3 *Ventilation:*

6.3.1 Ventilation may require a higher air exchange rate than a typical laboratory space.

6.3.2 In sample preparation spaces and evaluation rooms, local exhaust ventilation (LEV) can be used to immediately remove odors near the point of generation. It is best to remove odors from as close to the point of generation as possible.

6.3.3 When odors are generated more broadly, a larger space may require exhaust with a wider capture area.

6.3.4 Purge ventilation may be periodically necessary for short-term, high exhaust from laboratory spaces to remove odors generated during activities such as sample preparation.

6.3.5 Exhaust ventilation typically is vented out of the building space. Ensure the exhaust is not adjacent to any building air intakes. If exhaust requirements are excessive, it may be necessary to utilize filtration systems (for example, carbon) to clean and then return air to the laboratory space.

6.3.6 Pressure differentials between areas of the laboratory should be considered. Odor-free areas tend to be designed at positive pressure to keep odors out. Odorous areas tend to be designed at negative pressure to keep odors contained.

6.4 Work surfaces throughout the laboratory space should be selected for properties of low emissions and odor absorption as well as the ability to be easily and effectively cleaned.

6.5 Lighting and other laboratory features should also be considered. Review ASTM MNL60-2ND (**1**)[3] for detailed facility design guidance.

7. Assessor Selection and Training

7.1 *Assessor Selection:*

7.1.1 The assessor selection process should include the principles embodied in ASTM STP758 (**2**).

7.1.2 Assessors may be recruited from within the company or from the local community.

7.1.3 Internal employees allow for assessors to be on site and for control of proprietary information. However, this may cause resource and schedule conflicts since evaluations may not be the employees' primary job function.

7.1.4 Care must be taken to ensure that employees with technical knowledge of a project are excluded from evaluations to avoid significant biases.

7.1.5 Assessors must also be willing to observe rules such as not eating or chewing gum before a panel.

7.2 *Recruitment and Screening:*

7.2.1 Initial screening of assessors should determine availability and interest.

7.2.2 Potential assessors should not have any health-related problems that may interfere with their sense of smell, for example, severe allergies, migraines, sinus issues, etc. They must not have frequent aversions to odors or commonly experience adverse symptoms from odors (for example, headache, nausea, etc.). They should be checked for anosmia or hyperosmia to project related odors. Additionally, assessors with overall low sensitivity to odors or specific anosmia relevant to the study should be eliminated from consideration for the testing.

7.2.3 Potential assessors should be tested for their ability to identify and discriminate odors, either generally or specific to the test samples. Some screening examples include odor identification tests, odor threshold tests for standard odorants, and difference tests for similar or related odors, or both. Assessors might only be utilized for specific types of evaluation tests, so screening methods chosen should correspond to the evaluation methods for the sensory study. Various screening tests are commercially available, or samples can be prepared in-house (**3**, **4**, **5**).

7.2.4 Screening also may be conducted to test ability to complete basic ranking or rating activities. For example, ranking three samples of a standard odorant (for example, butanol, isovaleric acid, phenyl ethyl alcohol) at multiple concentrations in air or liquid solution. Screening methods should also be chosen that most directly match with project objectives.

7.2.5 A written program for assessor screening should be developed including clear criteria for acceptance and rejection of potential assessors for the training phase.

7.3 *Assessor Training:*

7.3.1 Training procedures will depend on the project objectives. The level of training should match the level of the evaluation task to be completed. For example, descriptive analysis training on multiple attributes will require significantly more training than ratings of overall odor intensity.

7.3.2 Specific training procedures will depend on the chosen odor attribute(s) and the qualitative or quantitative method(s).

7.3.3 Assessor training should be conducted by individuals having direct experience with appropriate sensory evaluation training and testing techniques.

7.3.4 A written training program should be developed including clear criteria for acceptance and rejection of the assessors as they progress through training.

7.3.5 The first step in training should be to orient assessors to general concepts of odor assessments and sensory evaluation

[3] The boldface numbers in parentheses refer to the list of references at the end of this standard.

testing procedures. This will include proper procedures for confidential and objective assessments.

7.3.6 Assessors may be introduced to simple rating and ranking activities, with activity difficulty increasing as skills are developed.

7.3.7 Group discussions, consensus activities and instant feedback training methods, especially in early phases, may help an assessor during training.

7.3.8 Presentation of samples with large, small, and no differences are helpful during training activities.

7.3.9 Assessors may need to be trained to understand conducting evaluations with background or substrate odors also present. For example, assessors are presented with olfactometer carbon filtered air or with control fabric swatches to experience and understand baseline background odors. Additionally, assessors may need to be trained to rate malodor(s) in the presence of a fragrance, as in consumer product evaluations including, but not limited to, laundry, hair care, and pet care products.

7.4 *Assessor and Panel Monitoring:*

7.4.1 Individual assessors should have continual monitoring to determine they do not have a shift in odor sensitivity and continue to meet performance criteria.

7.4.2 The panel, as a whole, should be monitored for on-going performance.

7.4.3 Control and reference samples can be presented during training and as part of on-going test session sample sets. This enables the evaluation of individual assessor ratings as well as the panel average ratings over time.

7.4.4 Replicate samples can be used for assessing individual and overall variability. This will provide information if assessors are *(1)* rating consistently higher or lower than the panel, and *(2)* if they are rating the same products consistently.

7.4.5 See Guide E3000 for specific details in measurement and tracking of assessors on a descriptive sensory panel.

8. Procedures

8.1 *Pretests:*

8.1.1 A practice session may be conducted with a small number of staff members or assessors to determine if the selected procedures are appropriate for a specific test. Sample preparation method, presentation method, number of samples, time between samples, number of attributes, etc. should be determined through pretesting and appropriately modified for the actual test.

8.2 *Product Variability:*

8.2.1 Variability exists in all products. How product variability is handled depends on the objective of the test, the size of the effect one is attempting to detect, and the risk associated with the decision being made. Unless the test is designed to understand the extent of variability, appropriate steps should be taken to minimize variability.

8.2.2 Sample variability considerations include, but are not limited to, parameters such as product lot, age, packaging, package size, and storage conditions. Test conditions and presentation procedures are determined by the test objective, test method, and test design. Descriptive tests or discrimination tests may have different sample requirements.

8.2.3 Product variability must be considered when preparing samples for testing. For example, individual samples may be blended and then portioned for evaluation, for example, hand lotion.

8.2.4 When testing is not representative of overall product variability, care should be used when generalizing results. For example, results from tests that include only one product lot are generalizable to that product lot; other lots may or may not behave similarly.

8.3 *Sample Preparation Tools:*

8.3.1 All materials coming in contact with the test samples during all preparation steps must be considered (for example, scoop, tongs, knife, weigh bowl, etc.). Tests should be performed to determine if a chosen material, with the given contact time, imparts any taint or absorbs odorants from the samples to be presented. Any materials chosen for use in sample preparation should be clean, odor-free, and non-reactive.

8.3.2 Consider the following when choosing containers and tools for sample preparation:

8.3.2.1 The need for lids to minimize off-gassing from the samples;

8.3.2.2 Material interactions, for example, odor transfer to/from sample container;

8.3.2.3 Maintenance of sample characteristics, for example, dimensions, surface area, shape, serving temperature, moisture level, combinations thereof, etc. The sample headspace must be consistent to provide the same dilution of odorants in the same air volume to be sniffed by the assessors;

8.3.2.4 Amount of sample needed for the specific evaluation; and

8.3.2.5 Ease of sample preparation and presentation to assessors.

8.4 *Sample Presentation:*

8.4.1 Samples may be evaluated with different presentation methods. Overall, the objective of the presentation method is to provide a sample to assessors to sniff, with considerations to improve the evaluation by *(1)* reducing variability in presentation, *(2)* directing the sample to the assessor's nose, *(3)* concentrating the odorants in the headspace to increase differentiation, and *(4)* providing a consistent method to execute in multiple testing sessions over the short and long term.

8.4.2 The samples are prepared with the presentation method in mind. Pretesting is needed to determine the best method for preparation including, but not limited to, container size, container material, holding temperature, holding time before first assessment, whether a single sample is evaluated by only one assessor or multiple assessors, and holding time between evaluations.

8.4.3 A procedure should be in place to confirm that any sample containers or chambers used in testing are odor-free.

8.4.4 With any presentation method, it is important for assessors to place their nose the same distance from the sample headspace as much as possible. Moving closer or further away from the material can change the perceived intensity and possibly other parameters of the sample.

8.4.5 Consider personal hygiene aspects of sample presentation methods. Assessors sniffing the same samples or sharing of equipment may require use of odor-free gloves or sanitizing of sample containers, equipment, and workspaces between assessor evaluations. A wipe sanitizer provides more application control than a spray sanitizer. If a sanitizer is used, careful selection should consider time for product odor to dissipate, the product should not leave a residual odor, and it should not interact with the test samples.

8.4.6 *Direct Sniffing:*

8.4.6.1 Direct sniffing may involve the assessor sniffing the product or material directly as they hold it, or a test administrator may maintain control of the sample by holding it as each assessor makes their evaluation.

8.4.6.2 The test administrator may need to be wearing odor-free gloves to eliminate odor from their hands and prevent interaction of the material with the test administrator's skin. It is best for the test administrator to hold the sample and have the assessor bring their nose to it rather than having the test administrator attempt to put the material near the assessor's nose.

8.4.6.3 Very low odor materials may not create a consistent headspace in a jar or chamber and evaluating the material directly by the nose may produce the most accurate result. This is an example of when low odor materials like textiles require direct evaluation.

8.4.6.4 A second example of direct evaluation is testing of large objects that cannot be placed in a jar or chamber.

8.4.6.5 An advantage of direct sniffing is that many assessors can sniff the same sample without a change in the odor presentation. However, the sample held in the open air can also create variability as odorants off-gas from the material.

8.4.7 *Closed Small Containers:*

8.4.7.1 The product or material may be placed inside a small container to create a headspace. Typically, small glass jars with lids or other small hand-held containers are used. This includes very small vials (1 to 5 mL) to large jars (1 to 2 L).

8.4.7.2 Lid material must be as non-reactive as possible, for example, Polytetrafluoroethylene (PTFE) lined lids. Other examples include a watch glass or aluminum foil placed over the jar opening.

8.4.7.3 Consideration needs to be made for the time and ease of removing and replacing the lids. A watch glass is easy to slide to the side to take a sniff and then return the cover. Screw-down lids are more secure but require more time to close and have a higher chance of being dropped by assessors.

8.4.7.4 Removal of a lid allows the headspace to escape; so multiple assessors sniffing from the same container may have different olfactory experiences. Pre-testing is needed to check if there is an appropriate hold time between evaluations if multiple assessors are sniffing the same samples, for example, 5 or 30 min. Additionally, if there is a 5 min hold between evaluations, the jar should be opened initially 5 min before the test start, otherwise the first assessor may receive a very different sensory experience. It is possible that no amount of hold time may be appropriate for recreating an equivalent olfactory experience. In this case, all assessors must have their own container sample prepared.

8.4.8 *Open Small Containers:*

8.4.8.1 Open small containers are the same as the closed containers except there is no lid. An open small container helps to concentrate the odorants from the product and material to funnel the odors to the nose of the assessor.

8.4.8.2 Open containers will have continuous odor emission into the lab spaces. Care needs to be taken during sample presentation to provide a separate chamber, storage area or adequate distance between samples to prevent cross contamination of the samples. The sample storage area must have proper ventilation to prevent odors from contaminating the assessor observation spaces. Time the samples are in the assessor evaluation space should also be minimized. For these reasons, open containers are more commonly used with lower odor materials.

8.4.9 *Chambers:*

8.4.9.1 Chambers tend to refer to containers that are too big to be held in your hands. Assessors commonly need to move to the chambers in the laboratory space.

8.4.9.2 Annex 3 in Guide E1593 describes chamber designs. Chambers may be of different sizes and materials. Materials should be selected to minimize adsorption or other interaction with samples. Examples include non-porous materials and stainless-steel.

8.4.9.3 Assessors sniff from chambers either with a sniff port or a larger opening (hatch) to sniff inside the chamber.

8.4.9.4 An advantage of chambers is that samples may be presented blind if the assessor sniffs from the chamber without seeing the samples.

8.4.9.5 Some chambers allow for assessors to walk into the chamber to make a fully immersive observation. In these cases, assessors may walk into the chamber with a carbon filter mask, nose plug or another non-odorous filtering material to delay observation until they have fully entered the chamber. Additionally, an air-lock or barrier may be designed into the chamber doorway to minimize transfer of air in or out while assessors enter and exit the chamber. Care should be taken to be certain assessors do not introduce odors to the chambers from their clothing or personal care products.

8.4.10 *Pressurized Devices:*

8.4.10.1 Pressurized devices, such as olfactometers, can either be custom made or commercially purchased. In this presentation method, the assessors receive the odorous air presented through a sniffing port (for example, cone/funnel, tube, or mask).

8.4.10.2 Pressurized devices are able to present the samples to assessors at controlled dilutions and at full-strength.

8.4.10.3 Olfactometers are able to present an odorous air sample to assessors at defined dilution ratios. Multiple dilution ratios allow for exploring how odor attributes of the sample (odor intensity, characters) change with dilution (Power Law) (**6**).

8.4.10.4 Olfactometers usually require the sample container or delivery path to stay at ambient pressure for the olfactometer to extract the odor at defined flow rate and dilution ratios. Samples are commonly placed into sample bags which are able to remain at ambient pressure until pressurized to direct air flow to the sniffing port. In other types of olfactometers, air or

nitrogen may flow across a sample in a jar or through a chamber before being directed to the sniffing port.

8.4.10.5 Typically, the test odor samples are prepared by placing product or material samples into a sample bag. In some cases, odorous air can be withdrawn using a syringe and injected into a bag or chamber. An alternative methodology for collecting odorous air samples into a sample bag is by passing air over the test material in a chamber or passing air through closed product packaging. This method can be helpful for collection of air from a package with limited headspace for assessment. For example, passing air through unopened medical device packaging at a very slow rate to capture the odors experienced while opening the package and then presenting the captured air to assessors with controlled presentation through an olfactometer.

8.4.10.6 Acceptable sample bag materials are polyvinyl fluoride (PVF), Polyethylene terephthalate (PET), and polytetrafluoroethylene (PTFE). Others may be found to be acceptable with validation testing.

8.4.10.7 An advantage of olfactometers is the active and controlled method of presenting the odor to the assessors. Samples can be presented blind and configured with a defined volume and flow rate. This can provide a more consistent odor evaluation experience between assessors.

8.4.10.8 Olfactometers and other pressurized devices require knowledge of proper operation and appropriate maintenance. Procedures must be in place to check air flow calibration of the systems.

8.4.10.9 With these devices, it is important to be aware of and test for any potential cross contamination of presentations from contaminated tubing or other surfaces within the system. These systems need to be purged between samples and tubing and other parts may need to be replaced or cleaned, or both.

8.4.11 *Substrates/Carriers:*

8.4.11.1 Some odor tests require use of a substrate or carrier. Examples include coatings (for example, paints and sealers), carpet cleaners, hair products.

8.4.11.2 Substrates and carriers are ideally odor-free or as low odor as possible. A hard surface cleaner may be tested on a ceramic or vinyl tile that is determined to be odor-free. Drywall or fiberboard for testing coatings may not be odor-free, but pretesting can determine lowest odor materials. Substrates purchased for a project can be placed in a ventilated space to allow the material to off-gas before use.

8.4.11.3 A substrate or carrier may be chosen for consumer relevance and not just based on criteria of being low odor or odor-free. For example, assessors evaluating how material substitutions change a baseline product odor.

8.4.11.4 If the substrate has a baseline odor, assessors may need to be presented substrate-only samples during orientation to understand odors of the substrate alone. During testing, a substrate-only control should be presented in the sample set for assessors to rate blind.

8.5 *Test Product and Material Preparation:*

8.5.1 *Sample Preparation Size*—Factors such as available material, presentation container or chamber size and thus available headspace, as well as the overall odor level are important elements when determining the sample size.

8.5.2 *Number of Samples*—Consider assessor adaptation/desensitization and mental fatigue when determining the number of samples to be evaluated in a test session. The odor intensity and character of the samples, mode of presentation, number of questions, and length of the test session should be taken into account when determining the number of samples to be evaluated per testing session and for the total project.

8.5.3 *Control Samples*—Under certain circumstances, it may be helpful to have control samples as part of a testing session. These controls could include, but are not exclusively, materials with known desired and undesired attributes or intensities of specific attributes, blank no-odor or substrate only samples, or benchmark reference samples. These samples should be presented blind to assessors.

8.5.4 *Sample Manipulation*—It may be appropriate to agitate, stir or otherwise manipulate a sample before assessment. Examples include swirling liquid in a jar before assessment, shaking cat litter, or rubbing fabric against itself or with the hand. Detailed instructions and demonstration must be provided to assessors for consistency. For example, swirling a jar on the table surface five times at a rate of two rotations per second. It is important for each assessor to be consistent with all samples and for there to be consistency among the assessors.

8.5.5 *Assessor Sniffing Techniques:*

8.5.5.1 Specific sniffing techniques can vary. Specification of a sniffing technique should be matched and justifiable to the test objective.

8.5.5.2 Sniffing for odor intensity is often done with a light, controlled sniff or short “bunny sniffs” as opposed to high volume “gulping” sniffs. Descriptive analysis may require multiple forms of sniffing to observe different attributes. For example, short initial sniffs may lead to observation of top note odor descriptors, while a second longer sniff may highlight other supporting odor characters.

8.5.5.3 Each assessor needs to use consistent sniffing techniques throughout any testing session. All assessors should use similar techniques, but most important is that each individual assessor is consistent. This includes sniffing rate, volume of sniff, and distance from the sample container opening or sniffing port.

8.5.5.4 When sniffing from small containers, it is important to consider how the sample may change from sniff to sniff. An assessor should be trained to always be prepared and observant when taking their first sniff from the sample. For smaller containers, some headspace will escape when the lid is removed. A second sniff from a container may already be lower in odor intensity and may even have different characters. It is always best to make judgments on the first sniff. Second or third sniffs are possible, and pretesting can help to consider how much this could affect judgements. The test objectives should always be considered and ensure the procedures meet the project objective.

8.5.5.5 Pretesting and study planning should evaluate the odor intensity and any possible trigeminal sensations elicited by the test samples to be certain presentation levels are reasonable, for example, not too strong.

8.5.6 *Olfactory Adaptation and Fatigue*—Precautions must be taken for assessors to avoid olfactory adaptation.

8.5.6.1 Olfactory adaptation could include: *(1)* short term olfactory desensitization, most commonly when presented with a very strong odor, and *(2)* adaptation to continuous or repeated exposure to similar odors, where many versions of similar fragrance are evaluated, and discrimination of the samples is decreasing. This could be during a day or over a longer period of time.

8.5.6.2 Overall fatigue (for example, mental fatigue) is also a concern where an assessor's performance decreases because of decrease in cognitive function.

8.5.6.3 Considerations and actions to minimize adaptation and fatigue:

(1) Combinations of time, number of samples, intensity of samples, character, and difficulty of the task (for example, number of attributes) all influence these issues.

(2) Ensure adequate breaks between samples. Length of breaktime needed depends on the evaluation task, for example, number of attributes to rate, as well as the type and strength of the test odors.

(3) In designing the experiment, consider how the number of samples could lead to fatigue of the assessors.

(4) Assessors may take several actions to help to reset their nose, which will then help the assessor regain focus and ability to evaluate the odors effectively. It is a common myth that coffee beans are necessary to reset olfactory fatigue (**7**). During a sensory test, it is not appropriate to add other odors in an effort to recover short term olfactory fatigue.

(5) The most common method to reset the nose is to take breaks in an area with fresh, odor-free air. Fresh air could include breathing carbon-filtered air (for example, room with carbon filtered air or masks with carbon filtration).

(6) Assessors may sniff their own skin as a neutral odor. For example, sniffing into the crook of their elbow or back of their hand.

(7) Sniffing of an odor-free fabric swatch, paper napkin, or paper towel may also be helpful for recovery.

8.5.7 *Presentation Temperature and Humidity:*

8.5.7.1 *Room Temperature Versus Elevated Temperature:*

(1) Consider the test objective and product or material use characteristics when determining sample presentation temperature. Temperatures should be consistent throughout testing.

(2) Sometimes specific attributes of samples presented at room temperature may not be differentiated. An example is odor intensity of toy raw material plastics. Elevating the temperature during sample containment holding time may increase the emission of odorants and allow for differentiation of the odor intensity or character profile.

(3) For materials used in high temperature conditions, for example, automotive interior plastics, testing may need to mimic use temperatures to characterize the odors.

(4) Heated samples may cool to room temperature rapidly once removed from an oven or other heat source. In some cases, the presentation ambient temperature may also need to be elevated. Pretesting can help determine appropriate temperature, length of holding time at elevated temperature, and effect of cooling before evaluation. For example, holding a sample at elevated temperature for a period of time, for example, 24 h, may lead to higher emissions of some odorants. If the sample container is sealed closed, cooling to room temperature will contain those odorants and pretesting can help to determine if those odorants remain in the container headspace or reabsorb into the test sample.

8.5.7.2 *Humidity:*

(1) Humidity is difficult to control precisely. All efforts should be made to keep humidity consistent during sample preparation and evaluation. Humidity should be measured and documented, and consideration should be made to determine if any results are affected.

(2) Objectives of projects may dictate preparation of samples in high humidity using small containers/chambers for the sample environment. For example, a study of odors from packaging (see Guide E619) may involve testing paperboard or other components held in jars under high humidity conditions.

(3) It may also be desired to mimic local humidity conditions relevant to where a product is used.

8.5.8 *Time Intervals:*

8.5.8.1 Pretesting will determine how much time is needed between samples. The key variables involved in determining the time intervals of sample presentation include:

(1) Time needed for the assessors to recover from short term sensory desensitization;

(2) Time for shared sample headspace to redevelop between assessments;

(3) Time needed for proper operation of presentation equipment (for example, olfactometer prime and purge time between samples);

(4) Time needed for assessors to move from waiting area to testing area (for example, booths, chambers).

8.5.8.2 If specific time intervals are required, steps need to be taken to ensure that all assessors maintain the same intervals. Timers, stopwatches, and time delay data acquisition computer screens may be helpful.

8.5.9 *Presentation Order:*

8.5.9.1 It is best to present samples using presentation design techniques to prevent order and carry-over effects.

8.5.9.2 Not all studies will allow for randomization of the presentation. For example, there may be a case where a material needs to be evaluated immediately after treatment. This may require evaluation of each sample one assessor after the other. Then all assessors evaluate the next sample after it is treated. In these cases, replicate samples or duplicating a test can be utilized to review potential presentation effects.

9. Evaluation Methods

9.1 ASTM MNL26-3RD (**8**) provides a thorough description of common sensory evaluation methods.

9.2 *Discrimination Methods, Ranking, Rating, and Descriptive Analysis:*

9.2.1 Discrimination methods, such as paired comparison (see Test Method E2164), triangle (see Test Method E1885), tetrad testing (see Test Method E3009) and others (for example, Test Method E2139) can be used to confirm differences in samples. These methods will provide information about whether differences are significant statistically; however,

alone they may not provide details as to how the samples are different or the magnitude of differences.

9.2.2 Ranking methods allow for direct comparison of two or more samples based on one or more attributes. It is possible for ranking methods to provide a measure of the degree of difference between samples.

9.2.3 Rating methods can be used for evaluation of the overall odor intensity. Various scales may be used for rating. For example, Practice E544 is a method for rating odor intensity with reference samples. Other scales are described in Guide E3041. Ratings may also be made of various attributes such as odor characters or trigeminal sensations.

9.2.4 Descriptive analysis can be utilized for a more detailed understanding of specific odor attributes of the product or material. See ASTM MNL13 (**9**).

9.3 *Number of Samples With Respect to Method Selected:*

9.3.1 The number of samples may influence the choice of evaluation method. For example, ranking or single attribute ratings may help screen samples to narrow down the number of samples of interest.

9.3.2 As the number of test samples is reduced, evaluation methods may be chosen to focus on attribute details.

9.4 *Odor Versus Trigeminal:*

9.4.1 It is important to be cognizant of trigeminal sensations (for example, irritation, cooling, burn) of samples. If trigeminal sensations are strong, the samples may be too uncomfortable for assessors to evaluate. These sensations may also bias rating results (for example, burning of ammonia leading to high odor intensity rating).

9.4.2 The intensity of trigeminal sensations may also be evaluated as long as comfort and safety of assessors is considered.

9.5 *Time Points of Evaluation:*

9.5.1 Time is often an important element of odor testing. As examples, studying the short-term change in odor of a fragrance after spraying would be on the order of minutes or the off-gassing odors from plastics would be on the order of days or longer.

9.5.2 The sample may only need to be prepared once and then evaluated at multiple time points. For example, the fragrance applied to a test chamber at time zero and then evaluated at 10, 30, 60 min, etc. after application.

9.5.3 The sample preparation may need to be completed multiple times. For example, the off-gassing plastic may need to be placed in a sniffing jar for headspace evaluation on day 1 and then removed to off-gas in a ventilated area. The sample is then prepared again in the sniffing jar on Day 30, etc. Sample preparation should remain consistent throughout testing.

9.5.4 The testing methodology should remain the same for the multiple time points.

9.6 *Relationships of Sensory and Instrumental Analysis:*

9.6.1 Attempts are frequently made to link evaluation of odor attributes to analytical instrumentation. This may be as simple as a one-to-one correlation of odor character intensity to specific compound concentration (for example, sulfur odor character linked to hydrogen sulfide concentration). More complex relationships involve relating the ratings of multiple odor descriptor attributes, or a single sensory attribute (such as intensity), with chemical analysis from instruments such as gas chromatography – mass spectroscopy (GC-MS).

9.6.2 When relating human sensory data to analytical instrumentation results, special consideration should be made that the samples utilized and sample preparation are as identical as possible.

10. Reporting

10.1 Documentation of all selected parameters and the reasons for decisions should be prepared. Parameters of concern include: number of assessors, sample size, sample preparation method, presentation method, sample presentation design, specific sniff techniques, hold time between assessments, evaluation method, and data analysis methods.

11. Keywords

11.1 fragrance; malodors; odor; olfactometry; trigeminal

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLE—JAR HEADSPACE—LIQUID EVALUATION

X1.1 A liquid material used in the manufacturing of a personal care product is being studied by the manufacturer to understand the potential odor levels of newly made material, older stored material, and variants between these samples.

X1.2 The odor study will begin with a small selection of samples and is expected to be on-going with new and aged samples.

X1.3 The manufacturer has trained a pool of twelve assessors. A minimum of five assessors will be used for any test.

X1.4 Samples are prepared with 30 mL material in 120 mL amber glass jars with PTFE-lined lids. Pretesting identified that 10 to 50 mL provided consistent results.

X1.5 Practice E544 was utilized to have the panel rate an overall odor intensity of the test samples. The assessors received the samples in a Williams presentation design to balance the sample presentation position and order. A 5-min break is observed by assessors between observations.

X1.6 Results allow for comparison of the odor intensity of the test samples to determine if there are aging parameters that