



## Standard Practice for Descriptive Skinfeel Analysis of Creams and Lotions<sup>1</sup>

This standard is issued under the fixed designation E 1490; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 The objective of this practice is to provide procedures that may be used in the design and analysis of studies of skin care products that compare qualitatively and quantitatively various sensory attributes and their intensity (or strength) over time. These properties can then be used to define the performance of skin care products to provide direction in product formulation, research guidance, and claim substantiation.

1.2 Guidelines are provided for the definition of each product attribute or term, range of the rating scales, procedures for the manipulation of product alone and on the skin, selection and training of panelists, handling of products, and skin conditioning prior to tests.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

E 253 Terminology Relating to Sensory Evaluation of Materials and Products<sup>2</sup>

### 3. Terminology

3.1 *Definitions*—Definitions of descriptive terms other than those given as follows appear in the procedure of Appendix X1.

3.1.1 *afterfeel*—the feel of the skin after application of the sample, with or without touching, usually measured at a set time interval.

3.1.2 *delivery*—the stage during which the product is discharged onto the finger(s) or skin.

3.1.3 *greasy*—a somewhat thick, sticky, either slightly resistant or slightly slippery film (for example, petrolatum).

3.1.4 *oily*—a thin, slippery, non-sticky film (for example, mineral oil).

3.1.5 *panel leader*—a person who is responsible for conducting descriptive panels and control product, protocols, and panel maintenance.

3.1.6 *pick-up*—the stage during which the product is manipulated between the fingers.

3.1.7 *reference anchors*—products that are used to demonstrate high or low intensities of a particular attribute.

3.1.8 *rub-out*—the stage during which the product is rubbed onto the skin.

3.1.9 *waxy*—a rigid, dry, somewhat resistant residue.

### 4. Summary of Practice

4.1 This practice provides for the identification of panelists selected and trained appropriately to evaluate the intensity and duration of defined sensory characteristics of skin care products. The details of specified procedures are defined in Sections 7 and 8 of this practice.

### 5. Significance and Use

5.1 The procedure recommended in this practice can be used to assess the sensory appearance and tactile properties of lotions and creams or ointment.

5.2 This practice is applicable to product categories that include skin lotions and creams; facial moisturizers; hand lotions and creams; and skin care products for which the appearance and tactile properties need to be assessed.

5.3 Procedures of the type described herein may be used to communicate perceived sensory properties (appearance and feel) between manufacturers and to the consumer through the media. These guidelines are suggested to meet the need for ascertaining the performance of experimental or commercial samples.

5.4 These procedures are to be used by persons who have familiarized themselves with the procedures and have had previous experience with sensory evaluation.

5.5 This practice provides suggested procedures and is not meant to exclude alternate procedures that may be effective in providing sensory evaluation descriptions.

### 6. Equipment

6.1 The following equipment may be used during the evaluation process.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee E18 on Sensory Evaluation of Materials and Products and is the direct responsibility of Subcommittee E 18.07 on Personal Care and Household Evaluation.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol. 15.07.

6.1.1 *Template*, used to outline the 2-in. (51-mm) diameter circles on the forearm. It assures that consistent, measured areas are delineated for product application and evaluation (for example, a flexible plastic material with 2-in. (51-mm) diameter circles cut out for outlining with an appropriate marker).

6.1.2 *Light Source/Viewing Conditions*—A consistent light source for each panelist is recommended for use during the evaluation of shine. The type of light source will depend on the specific nature of the product being evaluated. It is important that all panelists receive the same amount of light on the arms and the same angle of light, and that the distance from the test site and light be the same for each panelist (for example, high-intensity desk lamps).

6.1.3 *Skin Thermometer*.<sup>3</sup>

6.1.4 *Repeater Pipette*.

6.1.5 *Metronome*.

6.1.6 *Stopwatch*.

6.1.7 *Syringe*.

6.1.8 *Petri Dishes*.

6.1.9 *Weight Boats*.

6.1.10 *Hygrometer*.

## 7. Panel Selection and Training

7.1 *Objective*—To select and train a panel of 10 to 15 judges to evaluate the skinfeel properties (included in appearance, pick-up, rub-out, and afterfeel stages) of lotions and creams using a descriptive analysis method that quantifies several sensory attributes over time.

7.2 *Panel Selection*:

7.2.1 Panelists are recruited from within a company or the local community. The choice to use employees allows a company to have the panelists on site and to keep proprietary samples and information on site. The use of local community residents allows a company to schedule more panel time per week and provides a smaller risk to losing panelists both on a daily basis and long term.

7.2.2 A large group of candidates are recruited from the local community (50 to 75) by contacting community groups or placing newspaper ads, or both. Candidates from within the company are contacted by interoffice memo or notices posted on bulletin boards. Prior to the prescreening questionnaire, candidates should be informed of the time commitment for training (orientation and practice sessions), the potential duration of the panel, the use of the panel, and the expectation of each panelist in terms of commitment to the panel. The prescreening questionnaire is recommended for determining availability, interest, general knowledge of tactile properties, ability to use descriptive words, and ability to use rating scales (see Figs. 1-3).

7.2.3 The 20 to 30 candidates who score best on the prescreening questionnaire (see 7.2.5 for criteria) participate in the acuity screening phase (see Figs. 4 and 5). Candidates are asked to rate the intensity of skinfeel attributes for three

### SCREENING QUESTIONNAIRE

NAME \_\_\_\_\_ PHONE NO. \_\_\_\_\_  
 ADDRESS \_\_\_\_\_ (city/state) (zip code)

#### TIME

- ARE YOU CURRENTLY EMPLOYED OUTSIDE THE HOME? \_\_\_\_\_  
 IF YES, WHAT HOURS AND DAYS DO YOU WORK \_\_\_\_\_
- ARE THERE ANY WEEKDAYS, MONDAY THROUGH FRIDAY, THAT YOU WILL NOT BE AVAILABLE ON A REGULAR BASIS? \_\_\_\_\_  
 IF YES, WHAT HOURS AND DAYS ARE COMMITTED? \_\_\_\_\_
- DO YOU HAVE YOUR OWN MEANS OF TRANSPORTATION? \_\_\_\_\_

#### HEALTH

- HAVE YOU EVER HAD AN ALLERGIC OR ADVERSE REACTION TO ANY LOTION, FRAGRANCE OR CREAM? IF YES, DESCRIBE \_\_\_\_\_
- DO YOU HAVE ANY OF THE FOLLOWING?
 

	YES	NO
PSORIASIS	( )	( )
ECZEMA	( )	( )
CENTRAL NERVOUS SYSTEM DISORDER	( )	( )
UNUSUALLY COLD OR WARM HANDS	( )	( )
SKIN RASHES	( )	( )
CALLUSES ON HANDS/FINGERS	( )	( )
HYPERSENSITIVE SKIN	( )	( )
TINGLING IN THE FINGERS	( )	( )
- ARE YOU CURRENTLY TAKING ANY MEDICATION? PLEASE LIST \_\_\_\_\_

#### GENERAL

- DOES ANYONE IN YOUR IMMEDIATE FAMILY WORK FOR A CONSUMER PRODUCT COMPANY? \_\_\_\_\_
- DOES ANYONE IN YOUR IMMEDIATE FAMILY WORK FOR A PERSONAL CARE COMPANY? \_\_\_\_\_
- DOES ANYONE IN YOUR IMMEDIATE FAMILY OR SOMEONE YOU KNOW WELL WORK FOR A MARKETING RESEARCH OR ADVERTISING FIRM? \_\_\_\_\_

FIG. 1 Screening Questionnaire

#### TOUCH QUIZ

PLEASE ANSWER EACH QUESTION IN YOUR OWN WORDS

- WHAT TACTILE CHARACTERISTICS OF A LOTION WOULD MAKE YOU THINK IT IS RICH? \_\_\_\_\_
- WHAT IS THICKER, AN OILY OR GREASY FILM? \_\_\_\_\_
- WHEN YOU RUB AN OILY FILM ON YOUR SKIN, HOW DO YOU FINGERS MOVE? SLIP \_\_\_\_\_ OR DRAG \_\_\_\_\_ (CHECK ONE)
- WHAT PROPERTIES MAKE A TISSUE FEEL SOFT? \_\_\_\_\_
- HOW MIGHT THE APPEARANCE OF A HAND CREME INFLUENCE YOUR PERCEPTION OF THE FEEL OF IT? \_\_\_\_\_
- NAME SOME THINGS THAT ARE STICKY? \_\_\_\_\_
- WHEN YOUR SKIN FEELS MOIST, WHAT OTHER WORDS OR PROPERTIES COULD DESCRIBE IT? \_\_\_\_\_
- NAME SOME THINGS THAT ARE ROUGH \_\_\_\_\_  
 WHAT MAKES THEM ROUGH? \_\_\_\_\_
- BRIEFLY, HOW WOULD YOU DEFINE ABSORBENT IN A LOTION? \_\_\_\_\_
- WHAT PROPERTIES MAKE A DEODORANT FEEL STICKY? \_\_\_\_\_

FIG. 2 Touch Quiz

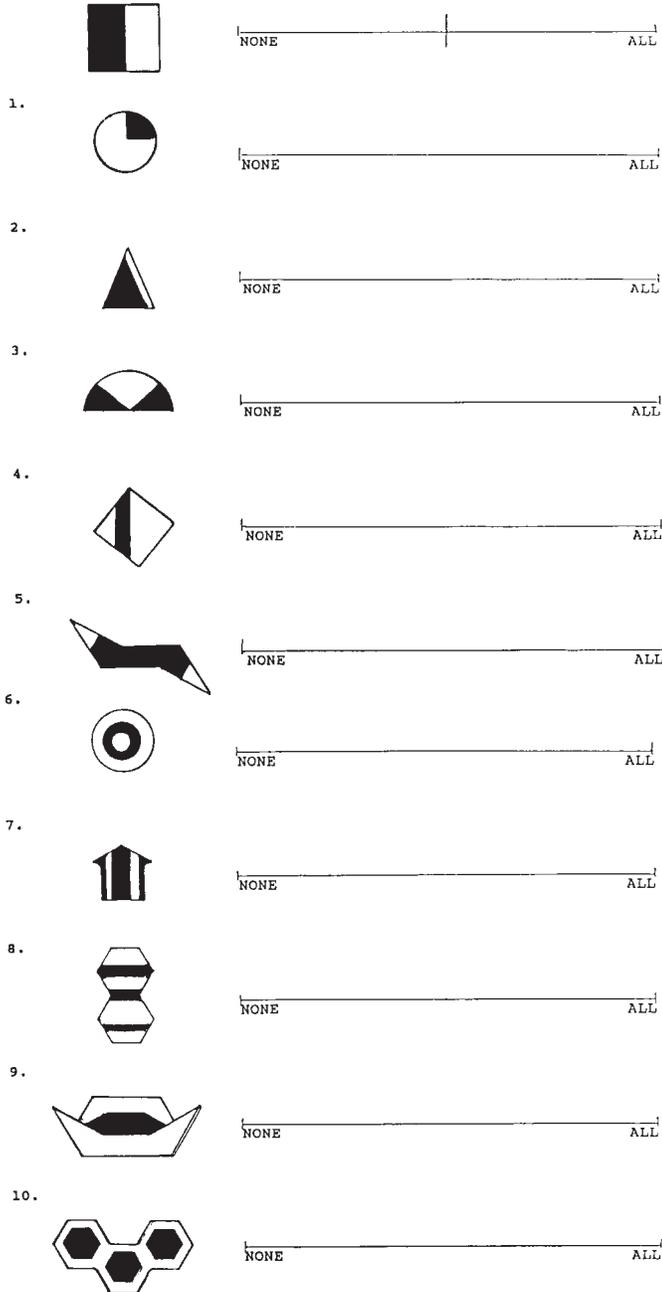
<sup>3</sup> Two telethermometers that would satisfy the guidelines identified in this practice are Telethermometer Model 44TA, marketed by YSI (Yellow Springs Instrument Company, Inc.), Yellow Springs, OH, or Digital Thermometer Model No. 5650 from Markson Science, Inc., Del Mar, CA.

samples chosen specifically to represent the range for the attributes tested. One attribute is chosen from each evaluation category: appearance (for example, integrity of shape), pick-up (for example, firmness or stickiness), rub-out (for example,

**SCALING EXERCISE**

INSTRUCTIONS: LOOK AT THE FIGURE ON THE LEFT. DETERMINE THE AMOUNT THAT IS SHADED. PLACE A MARK ON THE SCALE AT THE RIGHT TO INDICATE THE PROPORTION OF THE AREA THAT IS SHADED.

EXAMPLE:



**FIG. 3 Scaling Exercise**

ease to spread or whitening), and afterfeel (for example, greasiness or amount of residue). For rub-out and afterfeel attributes, the three test products are applied in premeasured amounts to three 2-in. (51-mm) circles on each arm. Use one arm for the rub-out evaluation and the other arm for the afterfeel attribute.

7.2.3.1 Candidates should have at least two products (of the three tested) rated properly for three of the four attributes in order to qualify as having sensory acuity.

**I. RATING EXERCISE**

Sample \_\_\_\_\_ Code \_\_\_\_\_

Ballot

Name \_\_\_\_\_ Date \_\_\_\_\_

Directions:

- o Place 1 drop of product \_\_\_\_\_ on forefinger tip of right hand.
- o Compress that drop GENTLY between the forefinger and thumb.
- o Estimate the AMOUNT of each attribute AS COMPARED TO MOST HAND LOTIONS.

THICKNESS: *Force to compress*

NONE \_\_\_\_\_ EXTREME

PEAKING: *Amount that the sample peaks (when fingers are pulled apart)*

NONE \_\_\_\_\_ EXTREME

WETNESS: *Amount of wet/watery feel to the product during compression or rotation of fingers*

NONE \_\_\_\_\_ EXTREME

**FIG. 4 Rating Exercise**

**II. DESCRIPTIVE EXERCISE**

Sample \_\_\_\_\_ Code \_\_\_\_\_

Ballot

Name \_\_\_\_\_ Date \_\_\_\_\_

Directions:

- o Place 1 drop of sample \_\_\_\_\_ on the back of your \_\_\_\_\_ hand.
- o Rub sample with index finger GENTLY in a CIRCULAR MOTION.
- o Describe what it feels like as you rub it.

o After the product is rubbed into your skin, wipe off your fingers only with a towelette. Do not touch product on back of your hand.

o Dry fingers with tissue.

o Feel the back of your \_\_\_\_\_ hand now and describe the way your skin feels.

**FIG. 5 Descriptive Exercise**

7.2.4 Each candidate is interviewed by the panel administrator or trainer to determine attitude, interest, ability to learn and work in a group dynamics situation, and availability for orientation, practice, and panel sessions on a routine basis (see Fig. 6).

INTERVIEW QUESTIONNAIRE

Name \_\_\_\_\_ Date \_\_\_\_\_

- Are you comfortable working in a group situation?  
\_\_\_\_\_
- How do you feel about voicing your opinion?  
\_\_\_\_\_
- How do you feel about opinionated people?  
\_\_\_\_\_
- How do you feel about committing your time to a training program?  
\_\_\_\_\_
- Are you interested in being a panelist?  
\_\_\_\_\_
- Do you have any questions for me?  
\_\_\_\_\_

Comments \_\_\_\_\_

Accepted: YES NO

FIG. 6 Interview Questionnaire

7.2.5 Select 10 to 15 panelists on the basis of the following criteria (see Figs. 7-12):

7.2.5.1 Availability for the complete orientation and 80 to 100 % of the practice sessions during training;

7.2.5.2 No health-related problems: skin irritations, central nervous system disorders, or medications that interfere with the central nervous system and could reduce skin and muscle sensitivity, and no previous history of allergy to lotions, creams, soaps, or other topical products;

7.2.5.3 Correct and comprehensive descriptive answers to 75 % or more of the open-ended tactile questions in the prescreening questionnaire;

7.2.5.4 Correct ratings of 80 % or more of the scaling exercise in the prescreening questionnaire;

7.2.5.5 Correct ratings for two samples (of the three per attribute) for three of the four attribute scales; and

7.2.5.6 Demonstration of good verbal skills, a high interest in descriptive and group dynamics tasks, and a cooperative yet confident personality demonstrated in the interview.

7.3 Panel Orientation:

7.3.1 To begin training of the 10 to 15 selected panelists, the panel trainer must orient panelists first to the general concepts, such as the definition, components, and applications of descriptive analysis testing. This takes 1 to 2 h.

7.3.2 Panelists are introduced to the need for strictly controlled procedures for the manipulation and application of samples and for the careful definition of each sensory attribute. This takes 1 to 2 h. (See Appendix X1 for procedures.)

7.3.3 Discussion and demonstration of each skinfeel attribute are conducted for each stage: appearance, pick-up, rub-out, and afterfeel. This establishes the overall structure of the descriptive analysis of skinfeel properties. Panelists are

SCREENING QUESTIONNAIRE

NAME \_\_\_\_\_ KEY \_\_\_\_\_ PHONE NO. \_\_\_\_\_

ADDRESS \_\_\_\_\_ (city/state) (zip code)

TIME

- ARE YOU CURRENTLY EMPLOYED OUTSIDE THE HOME? *check for conflict*  
IF YES, WHAT HOURS AND DAYS DO YOU WORK *check for conflict*
- ARE THERE ANY WEEKDAYS, MONDAY THROUGH FRIDAY, THAT YOU WILL NOT BE AVAILABLE ON A REGULAR BASIS? *check for conflict*  
IF YES, WHAT HOURS AND DAYS ARE COMMITTED? *check for conflict*
- DO YOU HAVE YOUR OWN MEANS OF TRANSPORTATION?  
*check for potential problem*

HEALTH

- HAVE YOU EVER HAD AN ALLERGIC OR ADVERSE REACTION TO ANY LOTION, FRAGRANCE OR CREAM? IF YES, DESCRIBE  
*check for severe reactions*
- DO YOU HAVE ANY OF THE FOLLOWING?
 

	YES	NO
PSORIASIS	( )	( X )
ECZEMA	( )	( X )
CENTRAL NERVOUS SYSTEM DISORDER	( )	( X )
UNUSUALLY COLD OR WARM HANDS	( )	( X )
SKIN RASHES	( )	( X )
CALLUSES ON HANDS/FINGERS	( )	( X )
HYPERSENSITIVE SKIN	( )	( X )
TINGLING IN THE FINGERS	( )	( X )
- ARE YOU CURRENTLY TAKING ANY MEDICATION?  
PLEASE LIST *check for medications that may affect the senses*

GENERAL

- DOES ANYONE IN YOUR IMMEDIATE FAMILY WORK FOR A CONSUMER PRODUCT COMPANY? *no*
- DOES ANYONE IN YOUR IMMEDIATE FAMILY WORK FOR A PERSONAL CARE COMPANY? *no*
- DOES ANYONE IN YOUR IMMEDIATE FAMILY OR SOMEONE YOU KNOW WELL WORK FOR A MARKETING RESEARCH OR ADVERTISING FIRM? *no*

FIG. 7 Key for Screening Questionnaire (Fig. 1)

TOUCH QUIZ

PLEASE ANSWER EACH QUESTION IN YOUR OWN WORDS

- WHAT TACTILE CHARACTERISTICS OF A LOTION WOULD MAKE YOU THINK IT IS RICH?  
*thick, viscous, creamy, firm, smooth*
- WHAT IS THICKER, AN OILY OR GREASY FILM? *greasy film*
- WHEN YOU RUB AN OILY FILM ON YOUR SKIN, HOW DO YOU FINGERS MOVE? SLIP  X  OR DRAG \_\_\_\_\_ (CHECK ONE)
- WHAT PROPERTIES MAKE A TISSUE FEEL SOFT? \_\_\_\_\_  
*not stiff, pliable, smooth, fuzzy, thick*
- HOW MIGHT THE APPEARANCE OF A HAND CREME INFLUENCE YOUR PERCEPTION OF THE FEEL OF IT? \_\_\_\_\_  
*thicker lotion = richer, moisturizing, thinner lotion = oily*
- NAME SOME THINGS THAT ARE STICKY? \_\_\_\_\_  
*honey, jelly, syrup, Vaseline*
- WHEN YOUR SKIN FEELS MOIST, WHAT OTHER WORDS OR PROPERTIES COULD DESCRIBE IT? \_\_\_\_\_  
*dewy, wet, oily, sweaty, clammy, greasy, moisturized*
- NAME SOME THINGS THAT ARE ROUGH? *concrete, emery board, toast*  
WHAT MAKES THEM ROUGH? *particles, stiffness, dryness*
- BRIEFLY, HOW WOULD YOU DEFINE ABSORBENT IN A LOTION? \_\_\_\_\_  
*An absorbent lotion is not greasy or oily and goes into the skin quickly*
- WHAT PROPERTIES MAKE A DEODORANT FEEL STICKY? \_\_\_\_\_  
*sticks to the skin/fingers, too wet, too thick*

FIG. 8 Key for Touch Quiz (Fig. 2)

encouraged to discuss each term, its definition, the protocol for evaluation, and the corresponding rating scale after they are demonstrated by the panel trainer. This takes 2 h (see Appendix X1).

I. RATING EXERCISE

Sample \_\_\_\_\_ Code \_\_\_\_\_

*The answers for the acuity tests depend on the samples chosen.*

Ballot

Name \_\_\_\_\_ Date \_\_\_\_\_

Directions:

- o Place 1 drop of product \_\_\_\_\_ on forefinger tip of right hand.
- o Compress that drop GENTLY between the forefinger and thumb.
- o Estimate the AMOUNT of each attribute AS COMPARED TO MOST HAND LOTIONS.

THICKNESS: Force to compress

NONE \_\_\_\_\_ EXTREME \_\_\_\_\_

PEAKING: Amount that the sample peaks (when fingers are pulled apart)

NONE \_\_\_\_\_ EXTREME \_\_\_\_\_

WETNESS: Amount of wet/watery feel to the product during compression or rotation of fingers

NONE \_\_\_\_\_ EXTREME \_\_\_\_\_

FIG. 9 Key for Rating Exercise (Fig. 4)

II. DESCRIPTIVE EXERCISE

Sample \_\_\_\_\_ Code \_\_\_\_\_

*The answers for the acuity tests depend on the samples chosen.*

Ballot

Name \_\_\_\_\_ Date \_\_\_\_\_

Directions:

- o Place 1 drop of sample \_\_\_\_\_ on the back of your \_\_\_\_\_ hand.
  - o Rub sample with index finger GENTLY in a CIRCULAR MOTION.
  - o Describe what it feels like as you rub it.
- \_\_\_\_\_
- \_\_\_\_\_
- o After the product is rubbed into your skin, wipe off your fingers only with a towelette. Do not touch product on back of your hand.
  - o Dry fingers with tissue.
  - o Feel the back of your \_\_\_\_\_ hand now and describe the way your skin feels.
- \_\_\_\_\_
- \_\_\_\_\_

FIG. 10 Key for Descriptive Exercise (Fig. 5)

7.3.4 For each skinfeel attribute, the procedure, definition, and scale are discussed and demonstrated using three to five references (if possible) that represent the full intensity range

INTERVIEW QUESTIONNAIRE

Name \_\_\_\_\_ Date \_\_\_\_\_

1. Are you comfortable working in a group situation?  
*yes, I think so*
2. How do you feel about voicing your opinion?  
*I am comfortable with voicing my opinion, I have no problem*
3. How do you feel about opinionated people?  
*They do not bother me*
4. How do you feel about committing your time to a training program?  
*It does not bother me, I am flexible*
5. Are you interested in being a panelist?  
*yes*
6. Do you have any questions for me?  
\_\_\_\_\_

Comments \_\_\_\_\_

Accepted: YES NO

FIG. 11 Key for Interview Questionnaire (Fig. 6)

from none or extremely low to very high. This exercise takes 4 to 5 h. (See Appendix X1 for high and low references for each attribute.)

7.4 Panel Practice:

7.4.1 Several practice sessions totaling 20 to 24 h are held to review the orientation material. These include the following:

7.4.1.1 Review of the procedure, definition, and rating scale for each attribute (approximately 10 to 12 h); and

7.4.1.2 Evaluation of one or two products; these are evaluated independently with the scale references, as needed (approximately 10 to 12 h).

7.4.2 Five to six pairs of samples (the samples in the pair should initially be quite different from each other) are evaluated on all attributes for all four stages: appearance, pick-up, rub-out, and afterfeel during the practice sessions (approximately 10 to 12 h).

7.5 Validation—Any one of the following methods can be used for panel validation.

7.5.1 Choose three different products from the same product category (lotions, creams, gels, mousses, etc.) that demonstrate significant differences on several attributes, as shown by an established panel. The panel results from the recently trained panel are compared to the results of the same samples from the established panel. The recently trained panel should provide similar results in 80 % of all attributes. This assumes 10 panelists in each panel.

7.5.2 Choose three different products from the same product category (lotions, creams, gels, mousses, etc.) that demonstrate significant differences on several attributes. The product evaluations of recently trained panels are compared to the results

SCALING EXERCISE

INSTRUCTIONS: LOOK AT THE FIGURE ON THE LEFT. DETERMINE THE AMOUNT THAT IS SHADED. PLACE A MARK ON THE SCALE AT THE RIGHT TO INDICATE THE PROPORTION OF THE AREA THAT IS SHADED.

EXAMPLE:

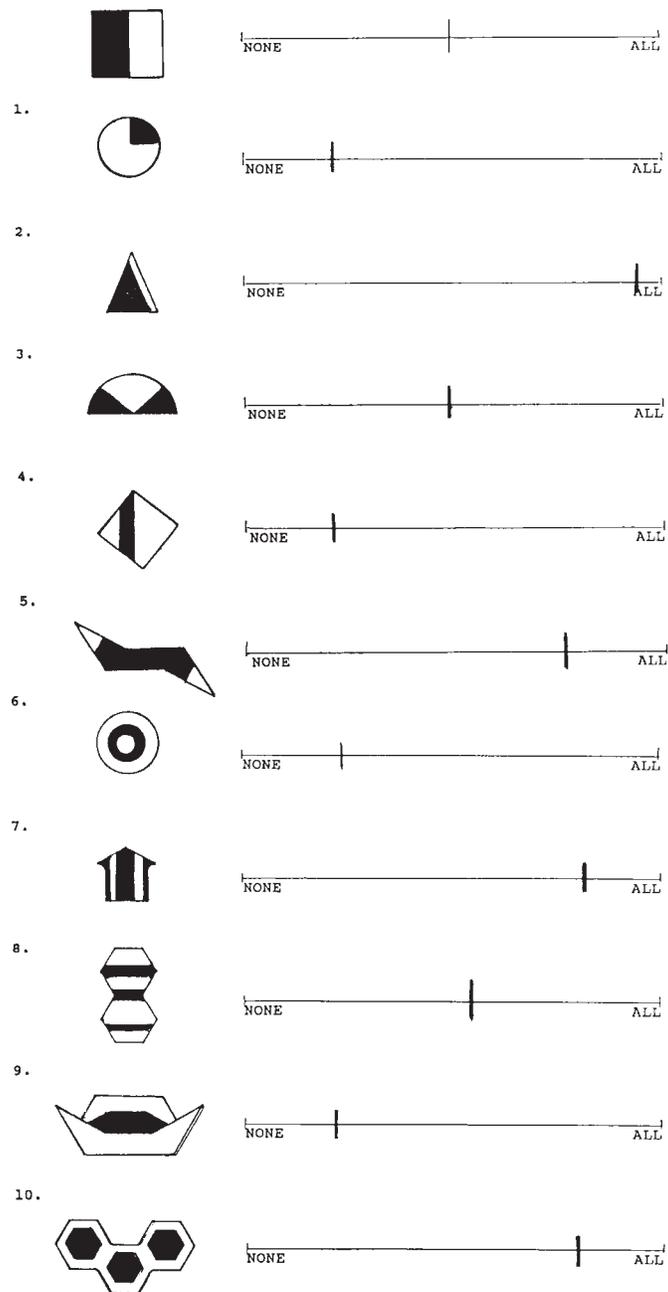


FIG. 12 Key for Scaling Exercise (Fig. 3)

made by instruments that simulate the way products are applied to the skin. The results of the panelists are validated by the correlation of the two sets of results (panel and instrumental).

NOTE 1—A lack of correlation may be a function of a poor choice of instrumentation measurement to simulate sensory product application or manipulation, or both.

7.5.3 Choose panel data across three different products from the results of the recently trained panel. Compare these data

with consumer attribute data for those attributes for which consumers have demonstrated understanding and an ability to differentiate among products. If the panel data correlates well with the previously validated consumer responses for similar attributes, the panel data can be considered valid.

NOTE 2—A lack of correlation may be a function of consumer terms that are not related to the panel attributes or that are not understood by the consumers.

7.6 Panel Monitoring—Three different factors can be monitored when reviewing data from the panel and panelists.

7.6.1 A measure of the variability within the panel (that is, among panel members) can be determined with three replications of three samples for all attributes and all panelists. The mean value and standard deviation for each sample for each attribute is computed. The panelists and panel leader can then look at the mean value for each sample and attribute versus each panelist's score. This permits the panel leader to see whether one or more panelists are rating consistently higher or lower than the panel as a whole on one or more attributes. Review of the standard deviations across attributes demonstrates whether some panelists have standard deviations that are more variable than most panelists and on which attributes. Large panel standard deviations indicate the need for a review of definitions, evaluation procedures, or reference standards for the attribute in question.

7.6.2 A measure of the repeatability of the panel as a whole can be monitored by analyzing three replications of the panel's evaluation of two or three samples of the same product type. An analysis of variance will determine whether the panel scores are the same for the same sample across the replicates. This analysis should be conducted for each attribute.

7.6.3 Analysis of the data collected from three replicates of two or three different samples (as used in 7.6.2) can provide information on judge-by-treatment interactions in the analysis of variance. A significant F value on any attribute indicates that one or more panelists are evaluating samples differently. Data for these attributes should be plotted to determine the panelists whose values are different from the panel as a whole.

7.6.4 After six months, repeat the procedure as outlined in 7.6.2.

7.7 Skin Types—Skin types, skin condition, and age should be considered when recruiting panelists for a skinfeel panel. This may be important because skin care products are frequently formulated to address the characteristics of a specific skin type, and panelists may generate varying product descriptions of particular attributes based on skin-type differences.

7.7.1 Pore Density—The pore density on forearms is fairly uniform and should not be a factor when using the volar forearm.

7.7.2 Sweat Thresholds—Temperature may cause differences from person to person if there are differences in sweat thresholds. This factor can be eliminated by conducting the evaluation in a temperature-controlled environment that is kept below sweat thresholds. (This threshold is used here to mean the temperature at which the level of sweating becomes noticeable. Some levels of sweating are not noticeable and can be ignored as part of normal water loss through the skin.)

## 8. Procedure (See Appendix X1)

8.1 *Sample Preconditioning*—Samples should be reconditioned prior to conducting the descriptive panel. Preconditioning consists of storing the samples in an area with similar temperature and humidity conditions (see 8.5) until the samples equilibrate to those conditions.

8.2 *Skin Preconditioning*—The panelists should not apply lotions, creams, or any topical products to the volar forearms for approximately 4 h prior to an evaluation session. The test sites may be reused within 4 h if the sites are cleansed and dried thoroughly. However, possible product buildup or residual effect, or both, from prior treatments may affect the rating of subsequent treatments.

8.3 *Preparation of Test Sites*—Prior to product application, the panelists should cleanse and prepare the test areas.

8.3.1 The panelists may wash each forearm at the test facility under supervised conditions prior to the evaluation session, or they may wash at home prior to the evaluation session. Immediately following the wash, the arms should be rinsed thoroughly with tepid tap water and dried thoroughly with absorbent paper towels.

8.3.1.1 A recommended procedure for a supervised cleansing would include a 10-s wash with an aqueous surfactant solution such as 5 % tea-lauryl sulfate (w/w).

8.3.2 Approximately 5 min after drying, the test sites (location for product application) should be marked on the forearms of each panelist. Using an appropriate skin marker (that is, eyebrow pencil or skin scribe), mark two 2-in. (51-mm) diameter circles on the inner aspect of the forearm. The circles should be located 2 in. (51 mm) above the wrist and 2 in. (51 mm) below the elbow.

8.4 *Skin Temperature Reading*—The skin temperature of the test sites may be measured 15 min after the wash procedure. During the 15-min wait, the panelists should be seated in the panel room.

8.4.1 The temperature of each site (2-in. (51-mm) circle) should be measured by placing the skin probe of the thermometer against the skin surface for approximately 60 s. Depending on the instrument used, the length of time per measurement may vary; however, the instrument should be used consistently among the panelists.

8.4.2 A record of the temperature readings should be placed in the study records. A history of skin temperature measurements may be used to correlate the effects of skin temperature with the rate of absorption, the within and between panelist variability, and other variables that may be influenced by skin temperature.

8.5 *Environmental Conditions*—The environmental conditions of the panel room should be controlled as much as possible.

8.5.1 For discussion and training, seating should be provided for the entire panel at a round table or in a table arrangement that facilitates group interaction. The panelists may sit at individual booths during the actual evaluation sessions.

8.5.2 All outside distractions and interruptions should be prohibited while the panel is in session.

8.5.3 The temperature level and, if possible, relative humidity of the panel room should be maintained at a constant level. Comfortable levels should be established by the panel leader prior to the start of the session. The comfort level of the panel members should be taken into consideration.

8.5.3.1 Ambient temperature and humidity readings should be recorded prior to the start of the session and at approximately every hour interval throughout. A drastic change in room temperature or relative humidity (that is, 5°F or 8 % relative humidity, or both) should be considered in the final interpretation of the data and noted in the final report. Immediately following such a drop, skin temperature measurements should be retaken (see 8.4).

8.5.4 Room lighting should be consistent for each panel member and remain standard within a given study. Individual lighting may be used during the appearance and afterfeel evaluations. If colored lighting is used to mask color differences in samples, it should be noted in the study records.

8.6 *Sample Delivery*—A uniform amount of the sample should be dispensed from a syringe or repeater pipette by the panel leader or an assistant.

8.6.1 The recommended amount for most lotions and creams is 0.05 cm<sup>3</sup>. Product amounts should not vary among judges or within a sample during an evaluation session. Syringes or pipettes should be loaded immediately prior to their use.

8.6.2 Weight boats may be used to dispense products too thick to be pulled up into a repeater pipette or a syringe. The product may be placed in (or onto the back of) the weight boat using a spatula. The product and weight boat should be weighed to ensure that a standard amount of the test product is dispensed. The panelist should be instructed to scoop the product out of the weight boat with a specified finger and place it on the forearm for evaluation.

### 8.7 *Sample Application:*

8.7.1 The sample is dispensed in the approximate center of the 2-in. (51-mm) circle. Immediately after the product is dispensed, the panelist uses a clean index or second finger to rotate the product in a circular manner within the test site. The direction of the circular rotations should remain constant.

8.7.2 A metronome may be used to ensure a consistent rate of product rotation among the panelists. It should be set at an established number of counts per minute so that the circular rub-in motion can be followed to the beat of the metronome by all panelists.

8.7.3 The samples may be dispensed to the same test site for each panelist so that each panelist evaluates the same test site at approximately the same time, or the samples may be balanced and randomized by location. The test site application pattern should be established by the panel leader prior to the start of the session.

8.7.4 The choice of which finger to use for spreading the sample should be determined prior to the start of the session. If the panelists decide to use the same finger for all applications, the finger should be cleaned and dried between use.

8.7.5 The test sites and application fingers may be reused if each is cleansed and dried thoroughly. However, possible

product buildup or residual effect, or both, from prior treatments may affect the rating of subsequent treatments.

8.8 *Rating Scales*—Refer to *ASTM STP 434*<sup>4</sup> or *ASTM STP 758*,<sup>5</sup> or both, for the type of rating scale to use to quantify the panel data.

8.9 *Test Design*—Refer to *ASTM STP 758*<sup>5</sup> for the various designs that may be used.

8.10 *Warm-Up Session*—The use of a warm-up session will depend on how often the panel is used and on the uniqueness of the test samples. If the panel does not meet frequently, it may be necessary to conduct a warm-up session with mock samples to reintroduce the panel to the procedures and attributes.

8.10.1 A test sample(s) that has unique or unusual properties should be introduced to the panel during a warm-up session since it may be necessary to modify the established procedure or perhaps develop a new attribute, or both.

8.10.2 The panel leader should make the final decision to conduct a warm-up session. This requires that the panel leader be very familiar with the procedures and references used by the panel. In addition, the panel leader should routinely evaluate the tactile properties of the test sample(s) on his/her own skin.

## 9. Report<sup>6</sup>

9.1 It is recommended that a final report be issued to the project leader or requester. Include the following elements in the report:<sup>7,8</sup>

9.1.1 *Summary*—A brief statement of the test objectives, procedures, results, and conclusions (less than 110 words).

9.1.2 *Objective*—An overview of the project or test objectives as agreed upon before the start of the experiment.

9.1.3 *Results*—A presentation and summary of the relevant collected data and statistical analysis.

9.1.4 *Discussion*—An interpretation of the theoretical and practical significance of the results and any relationships to previous knowledge.

## 10. Precision and Bias

10.1 Appendix X2 presents the details of a collaborative study that was conducted using the procedures recommended within this practice. Formulas for the test products evaluated and results of the study are also included in Appendix X2.

## 11. Keywords

11.1 cream; descriptive analysis; lotion; panelists; sensory; skin care products; skinfeel; tactile

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<sup>6</sup> Meilgaard, M., Civille, G. V., and Carr, B. T., *Sensory Evaluation Techniques*, CRC Press, Inc., Boca Raton, 1987, Vol 2, pp. 107–111.

<sup>7</sup> Close, J., Blank, R., Gelinis, A., and Penkin, N., “Sensory Evaluation: A Scientific Aid for R & D Chemists,” *Cosmetic Technology*, December 1982, pp. 42–45.

<sup>8</sup> Schwartz, N. O., “Adaptation of the Sensory Texture Profile Method to Skin Care Products,” *Journal of Texture Studies*, Vol 6, 1975, pp. 33–42.

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<sup>4</sup> *Manual on Sensory Testing Methods, ASTM STP 434*, ASTM, Philadelphia, PA.

<sup>5</sup> *Guidelines for the Selection and Training of Sensory Panel Members, ASTM STP 758*, ASTM, Philadelphia, PA.

## APPENDIXES

### (Nonmandatory Information)

#### X1. TABULAR DETAILS OF PROCEDURES FOR MANIPULATION AND APPLICATION OF SAMPLES

X1.1 See Tables X1.1-X1.4 for tabular details of procedures for manipulation and application of samples.

**TABLE X1.1 Product Delivery**
**Procedure:**

*Liquid or Low-Medium Viscosity Creams and Lotions in Tube, Pump, or Bottle*—Dispense the product using a nickel-size circle, filling from the edge to the center. Be sure to keep the petri dish on a flat, level surface.

*Jar or Thick Cream*—Scrape the product using a spatula onto a petri dish.

**Appearance Evaluation:**

Time	Observe	Definition	Source
Immediate	ease of dispensing	ease of squeezing or lifting product from the container: (not at all easy petrolatum very easy) water	CTFA dictionary
	amount of spread	distance that product spreads in petri dish: (none petrolatum high amount) mineral oil visc. sec. 85	CTFA dictionary
	integrity of shape (thickness)	degree product holds shape, peaks: (flattens mineral oil visc. sec. 85 retains shape) petrolatum	CTFA dictionary
After 10 s	integrity of shape (thickness)	degree product holds shape, peaks: (flattens mineral oil visc. sec. 85 retains shape) petrolatum	CTFA dictionary
	amount of spread	degree to which product spreads in petri dish: (none petrolatum retains shape) mineral oil visc. sec. 85	CTFA dictionary
	smoothness (appearance of surface)	degree of even surface, not marked by roughness: (not smooth, rough, lumpy regular farina cooked very smooth) mineral oil visc. sec. 85	cream of wheat CTFA dictionary
Tilt petri dish to see reflective properties; recommended gloss		angle of tilt is approximately 45° amount or degree of light reflected from product: (dull/flat shiny/glossy) dry cornstarch mineral oil visc. sec. 85	Argo Best Foods CTFA dictionary

**TABLE X1.2 Pick-Up Evaluation**
**Procedure:**

Evaluate one product at a time, rinsing fingers between samples with 5.0 % TEALS w/w, and then rinse with water and dry thoroughly.

Deliver 0.05 cm<sup>3</sup> onto a small petri dish.

Procedure	Observe	Definition	Source
Lightly tap product in petri dish using middle finger	amount of peaking	degree to which product stands up straight when tapped: (no peak mineral oil visc. sec. 85 high straight peak) zinc oxide ointment	CTFA dictionary USP XXI
Scoop remainder of product from the petri dish using the same finger			
Compress product slowly between index and thumb three times	firmness	force required to fully compress product between thumb and forefinger: (no force mineral oil visc. sec. 85 high force) lanolin wax	CTFA dictionary
Separate fingers slightly	stickiness	force required to separate fingers: (no force mineral oil visc. sec. 85 high force) AAA lanolin	CTFA dictionary
	stringiness	amount sample deforms or strains rather than breaks when fingers are separated: (low string/cohesion mineral oil visc. sec. 85 high string/cohesion) AAA lanolin	CTFA dictionary
Rotate fingers	denseness <sup>A</sup>	compactness of the product: (airy/light egg white whipped compact/heavy) petrolatum	CTFA dictionary

<sup>A</sup> Use only when applicable.

**TABLE X1.3 Rub-Out Evaluation**

Use skin scribe or eyebrow pencil to make a 2-in. (51-mm) diameter circle on forearm. Make sure that this circle is between the area 2 in. (51 mm) above the wrist and 2 in. (51 mm) below the elbow. Spread the pre-measured amount over the inscribed surface of the forearm with the index or middle finger, using gentle circular motions, at the designated rate of one to two strokes per second. The use of a mechanical device, such as a metronome, may be helpful in regulation of the timing.

Procedure	Observe	Definition	Source		
After 3 rubs	thermal melting	amount of change from a solid to semisolid to liquid state due to body heat and friction: (no change AAA lanolin	high amount of melting) coco butter	CTFA dictionary	
	spreadability	ease of moving the product over the skin: (difficult to spread/drag AAA lanolin	easy to spread/slip) 10 cs silicone oil	CTFA dictionary Dow Corning	
	wetness	amount of water perceived while rubbing: (none	high amount) water	CTFA dictionary	
	thickness	amount of product perceived between finger and skin: (no amount of product/thin Isopropyl alcohol	high amount of product/thick) petrolatum	CTFA dictionary	
	denseness	amount of compactness: (no amount egg whites	high amount) petrolatum	CTFA dictionary	
	thermal cooling	amount of cool sensation felt at the point of contact due to rate of product evaporation: (none	high amount) Isopropyl alcohol	CTFA dictionary	
	After 6, 9, 12, and 15 rubs	thermal melting	amount of change from a solid to semisolid to liquid state due to body heat and friction: (no change AAA lanolin	high amount of melting) coco butter	CTFA dictionary
		spreadability	ease of moving the product over the skin: (difficult to spread/drag AAA lanolin	easy to spread/slip) 10 cs silicone oil	CTFA dictionary Dow Corning
whitening <sup>A</sup>		degree product turns white when rubbed: (none mineral oil visc. sec. 85	high amount) Teals solutions <sup>B</sup>	CTFA dictionary	
Evaluate the following sensations when applicable (Develop scales and references if applicable)	chemical warm thermal cool chemical cool tingle				
Record number of rubs necessary to achieve total rub-in	absorbency	number of rubs when product loses the wet moist feeling and resistance to continued pressure is perceived			

<sup>A</sup> Evaluate only when applicable.

<sup>B</sup> **Warning**—Should be used with caution due to potential irritant.

**TABLE X1.4 Afterfeel Characteristics<sup>A</sup>**

Procedure	Observe	Definition	Source
Visually analyze forearm	appearance—gloss	amount or degree of light reflected off skin: (dull shiny) dry cornstarch timica sparkle	Mearl Corp.
Stroke cleansed fingers lightly across forearm	slipperiness	ease of moving fingers across skin: (difficult to move/drag easy to move/slip) AAA lanolin mineral oil	CTFA dictionary
	film—residue	indicate type and amount of product left on skin: (none high amount) Untreated skin waxy—schercernol behenyl erucate L-2195 greasy—petrolatum oily—mineral oil	CTFA dictionary
	moisture	amount of moisture perceived when moving fingers across skin: (none/dry high amount) water	
Tap fingers lightly over application site	sticky/adhesive (tacky)	Degree to which fingers adhere to residue product: (not sticky very sticky) untreated skin AAA lanolin	CTFA dictionary
Evaluate perceived sensation (develop scales and references if applicable)	chemical: cool warm burn tingle	kinesthetic: tautness	

<sup>A</sup> Post afterfeel evaluation—At 20 and 60 min following application, repeat the procedure for afterfeel characteristics.

## X2. DESCRIPTIVE SKINFEEL ANALYSIS OF LOTIONS AND CREAMS: COLLABORATIVE STUDY

### INTRODUCTION

The purpose of the collaborative study was two-fold. The first objective was to evaluate and optimize the mechanics of the identified procedure and the second was to demonstrate the degree of consistency for the method using preestablished skinfeel panels. Four established skinfeel panels evaluated two generic lotion materials using the methods described in this standard after brief training.

The details and results of the collaborative study have been included in this document to provide a benchmark for newly established panels and to share what was learned during the process.

The results of the collaborative study indicated good agreement among the panels for the attributes selected with the exception of revolutions (rate of absorption) and slipperiness. It should be noted that these two attributes are dependent on the variables of skin type, environmental conditions and training time, which were not tightly controlled during this study. These factors are important and should be controlled, as possible, when utilizing skinfeel panels. Discussion among participants of the study further indicated that retraining an established panel (for example, changing scales and references) was a difficult task.

The formulas selected by Committee E18 were anticipated to be different in skinfeel properties. Significant product differences were found across the panels for each attribute evaluated. This confirms that these formulas and the methods described in this collaborative study can serve as a useful training tool.

**X2.1 Panel Identification**—The following panels will participate in the October 1989 collaborative study and will be identified as follows:

Panel	Code
Avon	01
Sensory Spectrum	02
Hill Top Research	03
S.C. Johnson	04

Ballot coding:

Judge	Panel	Product
J01-10	01 = Avon	A = 786
J11-20	02 = SenSpec	B = 924
J21-30	03 = HTR	
J31-40	04 = SCJ	

### X2.2 Procedure:

#### X2.2.1 Questionnaire:

Scale: structured 0 to 10 point line scale  
Ballot: 16 scales (see Fig. X2.1)

**X2.2.2 Test Products**—Two generic lotion test materials will be evaluated during the course of this study. Each participating panel will evaluate products of the same batch or lot number, or both. Test materials will be stored at room temperature.

#### X2.3 Training Procedure

—Panels involved in this study

JUDGE PANEL PRODUCT

ROOM TEMPERATURE \_\_\_\_\_

RELATIVE HUMIDITY \_\_\_\_\_

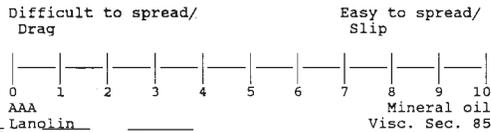
SKIN TEMPERATURE \_\_\_\_\_

RUB-OUT  
Evaluate at 10 rotations

1. WETNESS



2. SPREADABILITY



JUDGE PANEL PRODUCT

\* ROTATE FRESH SAMPLE ONTO SECOND APPLICATION SITE TO POINT OF ABSORPTION

POINT OF ABSORPTION: Point where product loses wet, moist feeling and resistance to continue rotating is perceived; or 120 revolutions (whichever comes first).

\* SET STOPWATCH TO START TIME FOR AFTERFEEL EVALUATION

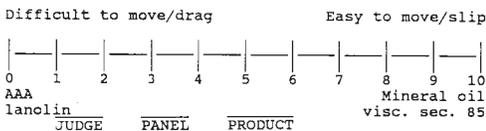
\* EVALUATE SKIN CHARACTERISTICS AT POINT OF ABSORPTION

3. Number of Revolutions to absorption: \_\_\_\_\_  
(upper limit = 120 revolutions)

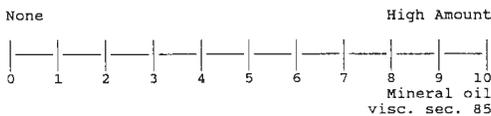
4. STICKINESS



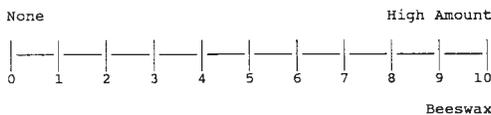
5. SLIPPERINESS



6. OILY



7. WAXY



8. GREASY

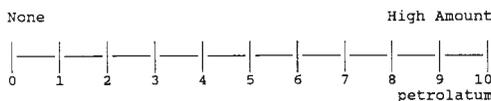


FIG. X2.1 Ballot: 16 Scales

JUDGE PANEL PRODUCT

APPEARANCE

\*Evaluate 10 seconds after dispensed by technician

9. Integrity of Shape



PICK-UP

10. Force required to compress fingers (firmness)



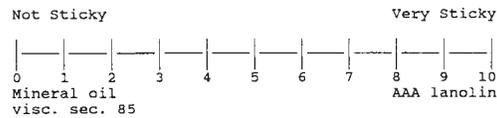
11. Force required to separate fingers (stickiness)



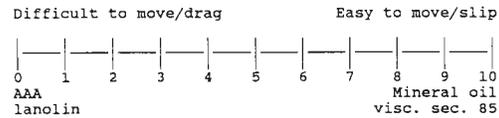
JUDGE PANEL PRODUCT

\*Evaluate at 20 minutes

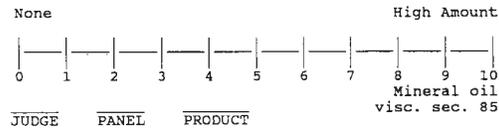
12. STICKINESS



13. SLIPPERINESS

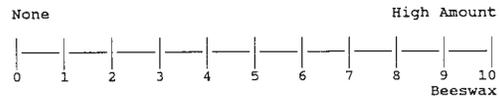


14. OILY



JUDGE PANEL PRODUCT

15. WAXY



16. GREASY

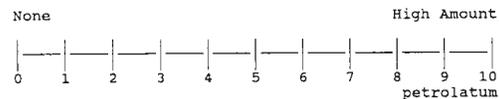


FIG. X2.1 Ballot: 16 Scales (continued)

are existing skinfeel descriptive panels at Avon Products, Inc., Hill Top Research, Inc., S.C. Johnson & Son, Inc., and Sensory Spectrum, Inc. Panel leaders for each panel are members of the ASTM Subcommittee E18.03 task group developing the practice for the descriptive evaluation of skin care products and the collaborative study subgroup of that task group. Each panel

leader is responsible for identifying and conducting training prior to test administration and familiarizing his or her panel with the proposed practice and reference standards for the study.

**X2.3.1 Evaluation Procedure**—The test products will be evaluated as outlined in X2.6. A copy of the ballot with the appropriate references identified appears in Fig. X2.1. The ballots prepared for the judges will not have the reference standards identified on them.

**X2.3.2 Test Supplies**—TEALS solution (5 % aqueous), skin scribe, standard syringes (3-cm<sup>3</sup> disposable), metronome, stop-watches, petri dishes (60-mm diameter pyrex), weight boats, hygrometer, thermometer (capable of measuring skin temperature), and 200 g of each test product.

**X2.3.3 Reference Standards**—1621 low-micron talc, water, AAA lanolin, titanium dioxide coated mica, lanolin wax, mineral oil (visc. sec. 85), petrolatum, and beeswax.

**X2.4 Placement**—One session will be required to complete the study. During the session, the first test sample evaluated will be applied to the left forearm, and the second test sample evaluated will be applied to the right forearm. Each judge will evaluate each test product once according to the randomization schedule (Exhibit B).

**X2.5 Analysis:**

**X2.5.1 Questionnaires** will be coded to identify the panel, judge, product, scale, and scale rating.

**X2.5.2 Data** will be analyzed using analysis of variance (ANOVA) and the least significant difference test.

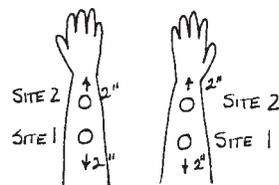
**X2.6 Collaborative Study Evaluation Procedure:**

**X2.6.1** Wash each forearm for 10 s with a 5 % aqueous solution of TEALS. Rinse with tepid water for 15 s. Dry thoroughly with an absorbent paper towel. Each judge must wait, at room temperature, for a minimum of 15 min before proceeding to the step given in X2.6.2.

**X2.6.2** Using a psychrometer, the test administrator will measure the relative humidity and temperature of the evaluation room. In addition, the skin temperature of each judge will be measured. This information will be recorded on the ballot prior to the start of the evaluation session.

**X2.6.3** Using a skin scribe, mark two-in. (51-mm) circles, 2 in. (51 mm) above the wrist and 2 in. (51 mm) below the elbow on the inner aspect of each forearm. The circles located near the elbows will be identified as Site 1, and the circles located near the wrists will be identified as Site 2. See Fig. X2.3.

**X2.6.4** Using a syringe, the test administrator will dispense 0.05 cm<sup>3</sup> of test product directly onto the first application site.



**FIG. X2.3 Diagram for Test Sites**

Product assignment for each judge will follow the predetermined randomization.

**X2.6.5** Using the index finger, the judge will rub the test sample around the test site ten times at a rate of 100 r/min. The rate of revolutions will be determined by the sound of a metronome.

**X2.6.6** At the tenth revolution, the judge stops and evaluates wetness and spreadability. The judge will mark a vertical line on the appropriate scales, indicating his or her scores.

**X2.6.7** The test administrator will dispense 0.05 cm<sup>3</sup> of product directly onto the second test site.

**X2.6.8** Using a second finger or a cleaned index finger, the judge will rub the test sample around the test site at a rate of 100 r/min until the product is absorbed. The point of absorption is defined as well as the point at which the product loses the wet, moist feeling and a resistance to continued pressure is perceived, or until 120 revolutions is reached.

**X2.6.9** The judge will set the stopwatch to start the time for the 20-min afterfeel evaluation.

**X2.6.10** The judge will record the number of revolutions to absorption and evaluate stickiness, slipperiness, oiliness, waxiness, and greasiness using the portion of arm indicated in Fig. X2.4.

**X2.6.11** During the 20-min waiting period, the judge will evaluate the integrity of the shape. The test administrator will dispense 1 cm<sup>3</sup> of product from a syringe onto a petri dish for each judge. The judge evaluates the integrity of the product's shape 10 s after it is dispensed.

**X2.6.12** Approximately 0.10 cm<sup>3</sup> of product will be dispensed onto the right thumb of each judge. Each judge will press the first finger against the thumb to determine the force required to compress the product. As the fingers are released, the force required to separate the fingers should be evaluated.

**X2.6.13** After 20 min of absorption, stickiness, slipperiness, oiliness, waxiness, and greasiness will be evaluated using the portions of the application site indicated above.

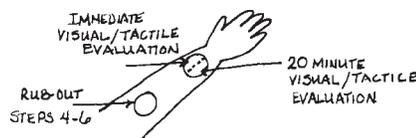


FIG. X2.4 Diagram for Test Evaluations

X3. DATA FOR FORMULAS 786 AND 924

TABLE X3.1 Formula 786

Water	69.20
Sequestrene NA <sub>3</sub> T	0.05
Tween 20	0.50
Carbopol 940	0.10
Beeswax	2.00
Polawax A31	2.00
Cetyl alcohol	1.50
Arlacel 165	3.50
White petrolatum	15.00
Methyl paraben	0.10
Ethyl paraben	0.05
Silicone 200/100	1.00
Glycerin 26	3.00
TEA	0.30
DI water	0.50
Germall 115	0.20
DI water	1.00

TABLE X3.2 Formula 924

Glyceral triodonate	2.00
Tri fat	5.00
Propyl paraben	0.20
Methyl paraben	0.20
Peg 100	1.50
Stearic acid	1.00
Carbopol 934	0.10
DI water	87.00
Glycerin	1.50
TEA	0.60
DI water	1.00

X3.1 See Table X3.1 and Table X3.2 for data on Formulas 786 and 924, respectively.

X4. DATA ANALYSIS: SKINFEEL PANEL EVALUATIONS

X4.1 Although this study design typically requires Repeated Measures ANOVA with a grouping factor, these data contained missed observations and an unequal number of panelists. Separate analyses were therefore performed to test specific contrasts. For example, see the following:

X4.1.1 Contrast No. 1 evaluated the difference between the two products within each panel.

X4.1.2 Contrast No. 2 evaluated the difference of two products averaged across the panelists.

X4.1.3 Contrast No 3 compared the panels with respect to the differences between each product.

X4.1.4 Contrast No. 4 compared panels with respect to their mean rating.

X4.2 Specifically, the following information is applicable:

X4.2.1 *Table X4.1, Product/Panel Attribute Score*—Calculated mean score for each attribute and panel.

X4.2.2 *Table X4.2, Average Differences Between Product's Rating by Panel*—Calculated the difference between two products in average rating.

X4.2.3 *Table X4.3, Significance of the Difference Between Two Products:*

X4.2.3.1 *Within Panel*—This was calculated, within each panel, the Student's *t*-test to determine whether differences exist in average ratings between the two products.

X4.2.3.2 *Main Effect*—A paired *t*-test was used to test the hypothesis that the average ratings of the two products were the same when averaged across all evaluators (N = 40).

X4.2.3.3 *Panel Effect*—ANOVA was used to test the hypothesis that the average difference in ratings between two products was the same for the four panels or whether the difference between the two products varied from panel to panel.

X4.2.4 *Table X4.4, Significance of Difference Between Panels*—ANOVA was used to test the hypothesis that the average attribute rating is in the same region of the scale for all four panels.

**TABLE X4.1 Average Ratings by Panel and Product**

Attribute	Product							
	786				924			
	Panel				Panel			
	1	2	3	4	1	2	3	4
<b>Rub-out</b>								
Wetness	4.51	5.59	6.22	2.12	6.91	7.86	8.22	6.33
Spreadability	5.88	6.47	5.23	4.81	8.36	8.06	8.33	8.15
Revolutions	42.56	86.70	84.20	72.80	42.22	94.00	111.50	88.20
Stickiness	5.28	2.86	5.41	6.55	4.73	0.70	2.16	3.37
Slipperiness	2.69	5.62	2.75	2.17	5.63	7.25	5.13	3.91
Oily	1.65	0.00	0.79	0.85	2.18	0.80	1.50	1.28
Waxy	4.05	2.11	3.97	3.91	2.86	1.11	1.19	2.31
Greasy	3.68	0.98	3.65	1.79	2.04	0.20	1.29	1.28
<b>10 s</b>								
Shape	8.67	9.14	9.50	8.05	3.96	4.41	3.03	2.39
Force-compress	4.68	4.71	5.49	4.12	2.43	1.65	1.40	0.97
Force-separate	3.91	3.78	5.58	4.56	1.76	1.34	1.64	1.32
<b>20 min</b>								
Stickiness	3.19	1.31	1.40	3.48	0.76	0.06	0.21	0.42
Slipperiness	4.94	7.25	4.51	3.44	7.92	7.98	5.01	6.90
Oily	1.02	0.00	0.75	0.77	0.13	0.00	0.23	0.56
Waxy	2.34	1.11	2.24	2.75	0.92	0.35	0.06	0.97
Greasy	2.81	0.50	1.73	1.38	0.74	0.00	0.05	0.60

**TABLE X4.2 Average Differences Between Products' Ratings by Panel**

Attribute	Difference = 786 – 924			
	Panel			
	1	2	3	4
<b>Rub-out</b>				
Wetness	-2.40	-2.27	-2.00	-4.21
Spreadability	-2.48	-1.59	-3.10	-3.34
Revolutions	0.33	-7.30	-27.30	-15.40
Stickiness	0.55	2.16	3.25	3.18
Slipperiness	-2.94	-1.63	-2.38	-1.74
Oily	-0.53	-0.80	-0.71	-0.43
Waxy	1.19	1.00	2.78	1.60
Greasy	1.64	0.78	2.36	0.51
<b>10 s</b>				
Shape	4.71	4.73	6.47	5.66
Force-compress	2.24	3.06	4.09	3.15
Force-separate	2.16	2.44	3.94	3.24
<b>20 min</b>				
Stickiness	2.43	1.25	1.19	3.06
Slipperiness	-2.98	-0.73	-0.50	-3.46
Oily	0.89	0.00	0.52	0.21
Waxy	1.42	0.76	2.18	1.78
Greasy	2.07	0.50	1.68	0.78

**TABLE X4.3 Significance of the Difference Between the Two Products**

Attribute	Within Panel <sup>A</sup>				Main Effect <sup>B</sup>	Panel Effect <sup>C</sup>
	1	2	3	4		
<b>Rub-out</b>						
Wetness	T <sup>D</sup>	S <sup>E</sup>	S	S	S	N <sup>F</sup>
Spreadability	S	S	S	S	S	N
Revolutions	N	N	S	S	S	S
Stickiness	N	S	S	S	S	T
Slipperiness	S	S	S	S	S	N
Oily	N	N	N	N	S	N
Waxy	N	S	S	S	S	N
Greasy	T	T	T	N	S	N
<b>10 s</b>						
Shape	T	S	S	S	S	N
Force-compress	N	S	S	S	S	N
Force-separate	T	S	S	S	S	N
<b>20 min</b>						
Stickiness	S	S	S	S	S	N
Slipperiness	S	S	T	S	S	S
Oily	T	N	T	N	S	T
Waxy	N	S	S	S	S	N
Greasy	T	S	T	T	S	N

<sup>A</sup> Within panel difference between the products is tested separately for each panel.

<sup>B</sup> Main effect difference between the products is tested by combining the data from all panels.

<sup>C</sup> Panel effect is the difference between the products as a function of the panel.

<sup>D</sup> T indicates trend; 0.05 ≤ P < 0.10.

<sup>E</sup> S indicates significant; P < 0.05.

<sup>F</sup> N indicates not significant; 0.10 ≤ P.

**TABLE X4.4 Significance of the Difference Between Panels**

Attribute	Product	
	786	924
Rub-out		
Wetness	S <sup>A</sup>	T <sup>B</sup>
Spreadability	N <sup>C</sup>	N
Revolutions	S	S
Stickiness	S	S
Slipperiness	S	S
Oily	S	N
Waxy	N	T
Greasy	T	N
10 s		
Shape	N	N
Force-compress	N	T
Force-separate	N	N
20 min		
Stickiness	S	N
Slipperiness	S	S
Oily	T	S
Waxy	N	N
Greasy	N	N

<sup>A</sup> S indicates significant;  $P < 0.05$ .

<sup>B</sup> T indicates trend;  $0.05 \leq P < 0.10$ .

<sup>C</sup> N indicates not significant;  $0.10 \leq P$ .

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