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Standard for the Systematic Verification of Alternative Training Aids for Detection Canine Disciplines

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Standard for the Systematic Verification of Alternative Training Aids for Detection Canine Disciplines

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Foreword

This Standard serves as a foundational document with requirements and recommendations for conducting verification tests of alternative training aids. This standard document establishes an overarching framework for chemical analysis and canine assessment, rather than providing comprehensive, detailed descriptions of the methodologies associated with either component.

This standard is applicable to and defines categories of alternative training aids for detection canines and addresses verification of alternative training aids by both analytical methods and canine testing. It describes a systematic process for assessing alternative training aids, including the instrumental chemical composition analysis and canine training efficacy.

This document includes descriptions on how to verify training aids using chemical analysis and assessment by canines. The intent is to provide the wide range of technical disciplines in the canine community (e.g., canine handlers, canine behavior scientists, chemical analysis scientists, and training aid producers) with the means to evaluate the alternative training aid for its use, as intended by the training aid producer. It is not the intent of this document to guide research and development of formulation or composition for training aid manufacturers. The users of the procedures described in this standard document includes training aid manufacturers, manufacturer-contracted laboratories, and any other interested third parties.

Verification assesses the strengths and limitations of training aids, resulting in reliable and scientifically supported recommendations for use and provides feedback to the canine community, manufacturers, and other producers of training aids.

The principles of good laboratory practice and record keeping will be applied to the concepts in this document. This standard is intended for use by competent practitioners with the requisite formal education, discipline-specific training, and demonstrated proficiency to perform the procedures described herein. This standard does not purport to address all of the possible 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 requirements prior to use.

Due to differences in sensitivity and selectivity between canines and instruments, the analytical limit of detection may not be equivalent[3], thus the standard provides a framework for training aid verification by both instrument and canine.

Current canine training aid verification research efforts may have reduced statistical rigor as other analytical chemistry measurements. This difference is due in part to the difficulty in recruiting a sufficient number of odor detection canines and handlers, or a sufficient number of detection canines with the proper threat signature training. In addition, some studies require that canines be tested on odors they have not previously encountered, which can be both difficult and costly to recruit or procure for training aid verification. As a result, the canine sample size may be too small to calculate statistically-based results.

A more complete discussion on the statistical considerations pertinent to canine training aid validation studies can be found in the follow-up companion document, currently under development, to be titled: Standard for the Canine Assessment of Training Aids for Detection Canine Discipline. To determine the minimum number of canines for a canine training aid validation study at a selected level of statistical confidence, the following references may also be consulted[5,6].

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The American Academy of Forensic Sciences established the Academy Standards Board (ASB) in 2015 with a vision of safeguarding Justice, Integrity and Fairness through Consensus Based American National Standards. To that end, the ASB develops consensus based forensic standards within a framework accredited by the American National Standards Institute (ANSI), and provides training to support those standards. ASB values integrity, scientific rigor, openness, due process, collaboration, excellence, diversity and inclusion. ASB is dedicated to developing and making freely accessible the highest quality documentary forensic science consensus Standards, Guidelines, Best Practices, and Technical Reports in a wide range of forensic science disciplines as a service to forensic practitioners and the legal system.

This document was revised, prepared, and finalized as a standard by the Dogs and Sensors Consensus Body of the AAFS Standards Board. The draft of this standard was developed by the Dogs and Sensors Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science.

Questions, comments, and suggestions for the improvement of this document can be sent to AAFS-ASB Secretariat, asb@aafs.org or 410 N 21st Street, Colorado Springs, CO 80904.

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Standard for the Systematic Verification of Alternative Training Aids for Detection Canine Disciplines

1 Scope

This standard provides requirements and recommendations for conducting verification tests of alternative training aids for detection canines and the process for assessing alternative training aids, including the instrumental chemical composition analysis (solid/liquid and headspace analysis) and canine training efficacy. This standard document stablishes an overarching framework for chemical analysis and canine assessment, rather than providing comprehensive, detailed descriptions of the methodologies associated with either component.

2 Normative References

The following reference is indispensable for the application of the standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. See Annex D, Bibliography, for informative references.

ANSI/ASB Standard 085, *Standard for Detection Canine Selection, Kenneling, and Healthcare*, 1st Ed., 2021[a].

ASB Technical Report 025, *Dogs and Sensors Terms and Definitions.*

3 Terms and Definitions

For purposes of this document, the following discipline specific definitions apply. Please refer to ASB Technical Report 025, *Crime Scene/Death Investigation – Dogs and Sensors – Terms and Definitions*, 1st Ed., 2017 for a comprehensive listing of detailed general canine detection definitions.

3.1
alternative training aid
Any type of training material that does not use target material as ordinarily encountered by detection canine while deployed.

NOTE 1 An aid is commonly used in situations where the true material is hazardous, has limited availability, or controlled access.

NOTE 2 Aid subclassifications include Sorption, Mimic, and Dilution. Vigilance Aids may also be alternative training aids.

3.2
alternative training aid detection canine/group
A canine(s) that has not previously been trained to or have known incidental exposure to the target odor related to the training aid being verified.

NOTE 1 For verifying alternative training aids, these canines are trained on the alternative training aid.

NOTE 2 This type of canine is also known as a “true canine”.

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3.2
baseline capability assessment
An odor recognition assessment test that evaluates a canine's response to target materials.

NOTE 1 In the case of training aid verification, for the control group, the baseline capability assessment tests the proficiency of the canine team to locate the true material.

NOTE 2 In the case of training aid verification, for the experimental group, the baseline capability assessment tests the proficiency of the canine team to locate the alternative training aid.

3.3
blank
(1) Any area or container where target odor is not present (canine testing, assessment, and certification definition).

(2) A control where a specified component(s) is not present (instrumental definition).

NOTE Blanks with various designations can be specified, such as system blank, process blank, method blank, reagent blank, solvent blank, etc. Certain blanks may also serve as a negative control.
[ASTM E3255-21]

3.4
blank training aid
A training aid composed of all the training aid materials except the target compound(s), such as substrate, containment, solvent, etc.

NOTE 1 The blank training aid has undergone all of the same manufacturing procedures as the training aid.

NOTE 2 Also known as negative control.

3.5
canine team training personnel
A person responsible for training canines and canine handlers.

NOTE This person performs the maintenance training and proficiency training in the field, and train canines in preparation for a formal course of instruction.

3.6
containment system
Any means of restricting target odor to prevent cross-contamination, odor dispersion, or odor transfer of any means of limiting access to training aid sources during training or certification to prevent consumption, movement, or relocation.

3.7
data recorder
The personnel involved in recording the canine or canine team response or other canine behavior data, such as change of behavior.

3.8
dilution aid
The liquid- or solid-phase target material added to or encapsulated into a substrate.

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NOTE Dilution aids are commonly used to render the target material less hazardous.

3.9
dynamic headspace sampling
An extraction technique in which a portion of the headspace vapors is exchanged from the sampling container and concentrated onto an adsorbent or absorbent medium through applied positive or negative pressure.
[ASTM E30.13 E1413 – 19, E3189 – 19, E3197 – 23 MOD]

3.10
gas chromatography-electron capture detection
GC/ECD
A method of analysis in which substances are separated by differential migration in a gas mobile phase flowing through or past a stationary phase [gas chromatography (GC)] coupled with a detection technique [electron capture detection (ECD)].

3.11
gas chromatography-mass spectrometry
GC/MS
A method of analysis in which substances are separated by differential migration in a gas mobile phase flowing through or past a stationary phase [gas chromatography (GC)] coupled with a detection technique [mass spectrometry (MS)].

3.12
generalization assessment
An odor recognition assessment that tests a canine's response to untrained target materials following specific training on related target materials.

NOTE Specific to this standard, in the case of training aid verification, for the true training aid detection canine group, the generalization assessment tests the proficiency of the canine team to locate the alternative training aid, and for the alternative training aid detection canine group, the generalization assessment tests the proficiency of the canine team to locate the true material.

3.13
headspace
The space above a material that includes the vapors produced by the liquid or solid material.

3.14
headspace analysis
The practice for sampling and analyzing the headspace.
[ASTM E30.92 E3197 – 23 MOD[

3.15
linear regression
A model that identifies the best-fit linear relationship between the instrument response (Y) and the concentration of the analyte in the calibrator (X).

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3.16
liquid chromatography – mass spectrometry
LC/MS
A method of analysis in which substances are separated by their differential migration in a liquid mobile phase flowing through or past a stationary phase [liquid chromatography (LC)] coupled with a detection technique [mass spectrometry (MS)].

3.17
liquid chromatography – ultraviolet spectroscopy
LC/UV
A method of analysis in which substances are separated by their differential migration in a liquid mobile phase flowing through or past a stationary phase [liquid chromatography (LC)] coupled with a detection technique [ultraviolet spectroscopy (UV)].

3.18
mimic aid
A chemical selected with the goal of imitating the real odor of a target material.

NOTE In addition to the targeted chemicals, the aid may include a substrate material.

3.19
primary containment layer
Refers to the direct, immediate layer that holds the target material (explosive, illicit drug, etc. or the simulated substance used for training purposes).

NOTE 1 This layer is responsible for physically containing the substance and preventing it from leaking, spilling, or emitting odors prematurely.

NOTE 2 This could be a variety of materials (e.g., plastic bag, linen bag, glass vial).

3.20 primary verification
A process of evaluation for newly developed or previously untested alternative training aids per end-user requirements and/or knowledge

3.21
secondary containment layer
This layer of containment has the primary purpose to provide an additional level of security, ensuring that even if the primary containment fails or leaks, the substance will still be contained or protected.

NOTE The secondary containment is often designed to mitigate the risk of exposure to the environment, the canine, or the handler, and it also minimizes odor release.

secondary verification
A process of evaluation to verify producer's claims and ensure that the training aid continues to meet parameters defined in the training aid primary verification.

3.22
semi-quantification
Approximation of the concentration or mass of a substance relative to a known standard or other reference sample, rather than determining the exact concentration.

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NOTE For analysis based on SPME extraction or other non-exhaustive extraction methods, semi-quantification may utilize a calibration curve, similar to absolute quantification; however, it is still considered semi-quantitative because the mass on fiber (or extraction substrate) is being determined not the total concentration or mass in the headspace.

3.23
static headspace sampling
An extraction technique in which a portion of the headspace vapor(s) or aerosol(s) are removed from the sample container and concentrated onto an ad/absorbent medium.

3.24
solid-phase microextraction
SPME
An extraction technique where the analytes from a sample are sorbed onto a fiber coated with an adsorptive or absorptive medium.

3.25
solvent extraction
The transfer of chemical compounds from a material to a solvent (can be solid-liquid but can also be liquid-liquid).

3.26
sorbent tube
A sample apparatus in which the sample is pumped into a tube(s) packed with one or more sorbents.

NOTE Frequently used for sample collection and sample introduction by thermal desorption (commonly referred to as thermal desorption tube)

3.27
sorption aid
A training aid created through the collection of a gas-phase compound(s) from a targeted material. (See **3.19 alternative training aid**.)

NOTE 1 Sorption aids could be made using true material(s) or from another alternative training aid.

NOTE 2 Sorption aids are commonly referred to as "odor soaks". Soaking of a liquid or solid target material onto a substrate is considered a dilution aid. (See **3.152 dilution aid**.)

3.28
test administrator
Personnel involved in administering an assessment.

NOTE This person may set-up assessment or provide feedback on handler indications.

3.29
thermal desorption (sample introduction technique)
A method of introducing a sample that was collected on a sorbent substrate into an instrument for analysis using heat and a flow of gas to transfer the compounds for analysis.

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3.30
training aid verification
Provision of objective evidence that a given training aid fulfils specified requirements.

NOTE 1 Primary training aid verification includes chemical analysis (headspace and/or solid/liquid analysis) and canine odor recognition assessment and is used for newly developed or previously untested alternative training aids per end-user requirements and/or knowledge.

NOTE 2 Secondary training aid verification includes chemical analysis (headspace and/or solid/liquid analysis) and is used to verify producer's claims and to ensure that the training aid continues to meet parameters defined in the primary training aid verification.

3.31
training aid readiness level
TARL
The degree of foundational research and development relating to both canine and instrumental testing for the verification and deployment of a canine detection training aid (see Annex B and C for detailed description).

3.32
true material
Authentic target substance (e.g., explosive material purchased from explosive manufacturer or human remains), or target as would be encountered by detection canine while deployed (e.g., confiscated drug mixture), as opposed to an **3.1 alternative training aid**.

3.33
true training aid detection canine/group
Canine(s) trained in the detection of the odor emanating from a true material and certified or otherwise shown to be proficient in its detection.

NOTE 1 For verifying alternative training aids, these canines are trained on the true material(s) prior to being used for training aid assessment.

NOTE 2 This type of canine is also known as a "true canine".

4 Requirements and Recommendations

4.1 Overview

4.1.1 Table 1 and Figure 1 describe the minimum primary verification level for newly developed or previously untested aids and the minimum secondary verification level for regular production testing after primary verification has occurred.

4.1.2 Annex A describes alternative training aids included in Figure 1.

4.1.3 Verification shall demonstrate training aids are reliable and suitable for their intended purpose prior to operational use.

4.1.4 Qualitatively, an ideal alternative training aid has the same target compounds as the true material. Quantitatively, the target compounds in an ideal alternative training aid are in relative abundance compared to the background compounds.

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Table 1—Evaluation of Training Aids

Primary verification (newly developed or previously untested training aids)	Secondary verification (production testing)
1. Material (solid, liquid) analysis 2. Headspace analysis 3. Canine testing	1. Headspace analysis (preferred) 2. Material (solid, liquid) analysis

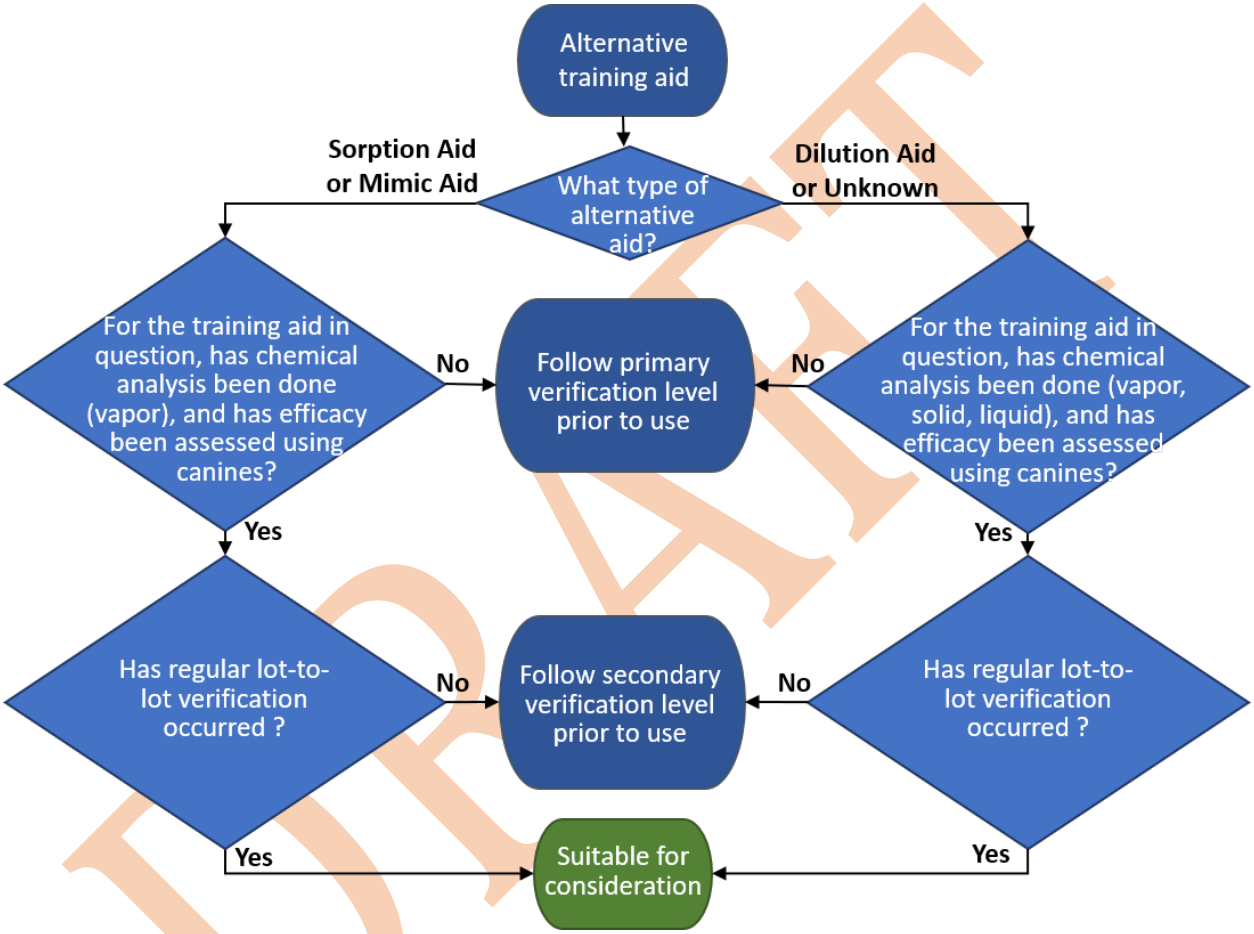


Figure 1—Evaluation of a Training Aid

4.1.5 Verification by chemical analysis should include third-party testing using laboratories that have established and documented analytical testing capabilities to carry out the protocols detailed Sections 4.4 and 4.5.

NOTE This standard is intended to be carried out in an analytical laboratory with ISO 17025 accreditation, equivalent accreditation, or similar quality assurance protocols, and with the proper space, equipment, and personnel to carry out the procedures described herein.

4.1.6 Verification by canine testing should include third-party testing using entities that have established and documented testing capabilities to carry out the protocols detailed Section 4.6.

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4.1.7 The true training aid detection canine group should generalize to the alternative training aid, and the alternative training aid detection canine group should generalize to the true material with minimal false responses, as defined in the test parameters.

4.1.8 Verification by canine assessment is intended to be carried out by performers that have established and documented canine testing capabilities to carry out the protocols detailed in 4.6 and conducted using protocols that have been approved by a governing body, such as an Institutional Animal Care and Use Committee (IACUC), as appropriate.

4.1.9 Verification information shall be made available in the form of reports to potential end users.

4.1.10 The shelf-life should be characterized as a part of primary verification; however, the methods for shelf-life determination are beyond the scope of this standard.

4.2 Primary Verification Level

4.2.1 Primary verification shall be conducted to confirm that a newly developed or previously untested alternative training aid meets the claims of the producer and end-user requirements.

NOTE Minor changes, such as changing the substrate product line (e.g., filter paper substrate from different manufacturers) do not warrant re-conducting primary verification. More extensive changes, such as changing the training aid substrate from filter paper to sand, is a sufficient change to warrant re-conducting primary verification

4.2.2 Primary verification shall include both instrumental chemical composition analysis (qualitative, semi-quantitative, or quantitative) and canine testing.

4.2.3 Instrumental chemical composition analysis includes the steps in 4.2.3.1 through 4.2.3.4.

4.2.3.1 For sorption and mimic aids, the chemical(s) present in the headspace shall be characterized (Figure 2a).

4.2.3.2 For sorption and mimic aids, the chemical(s) present in the solid and liquid phases should be characterized (Figure 2b).

4.2.3.3 For dilution aid or if alternative training aid type is unknown, the chemical(s) present in the headspace shall be characterized (Figure 2a).

4.2.3.4 For dilution aid or if alternative training aid type is unknown chemical(s) present in the solid or liquid phases shall be characterized (Figure 2b).

4.2.4 Odor recognition assessments of the alternative training aid shall include detection canines that have not been previously trained for the corresponding detection discipline (alternative group) and detection canines that have been trained for the corresponding detection discipline (true group) (Figure 3).

4.2.5 Primary verification testing results shall be documented in a report and access to the report shall be available without requirement of purchase (see Section 5).

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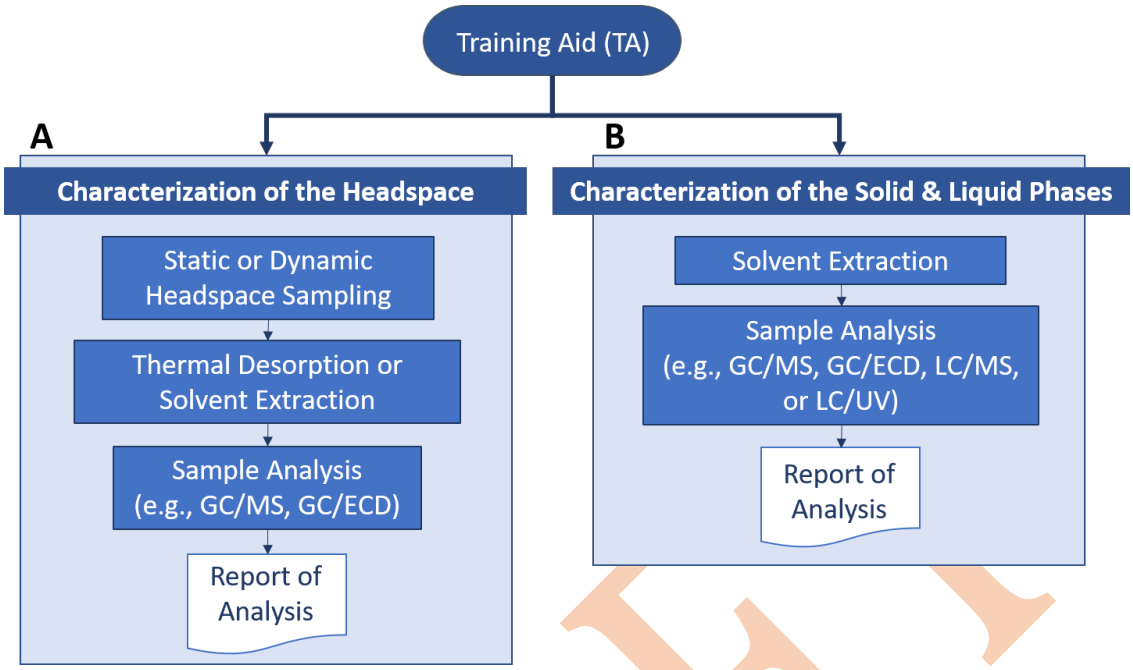


Figure 2—Characterization of the (a) Headspace, and (b) Solid and Liquid Phases

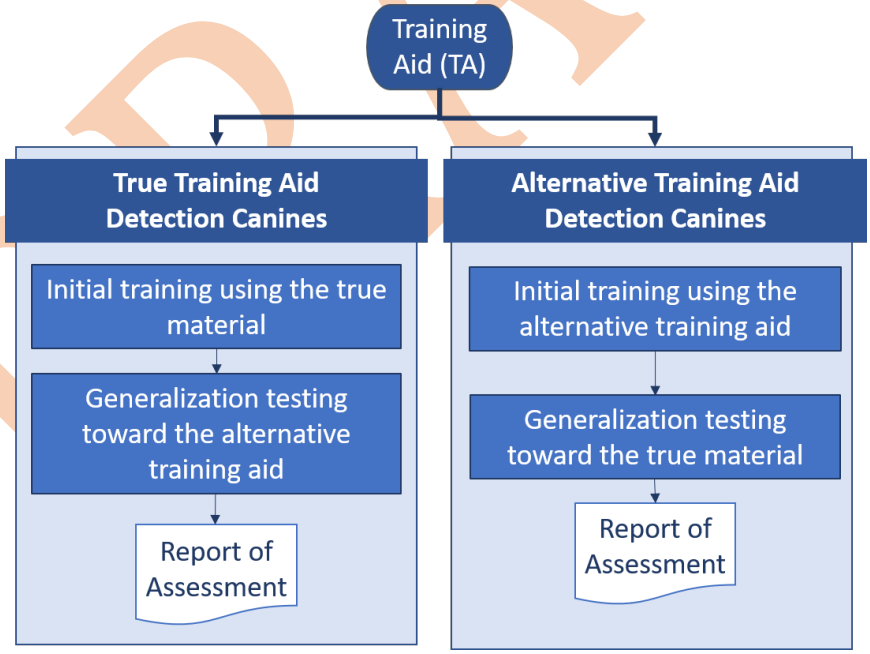


Figure 3—Canine Testing Design for Primary Verification of an Alternative Training Aid Using True and Alternative Training Aid Detection Canines

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4.3 Secondary Verification

4.3.1 The results of primary verification defines the parameters to be met by secondary verification, therefore, secondary verification shall not be done in lieu of primary verification.

4.3.2 Secondary verification should be conducted to verify producer's claims and ensure that the training aid continues to meet parameters defined in the primary verification.

4.3.3 Acceptable deviations from primary verification of future secondary verifications results shall be defined prior to secondary verification.

NOTE Acceptable deviations may be based on manufacturer process, previous testing, end-user requirements, etc.

4.3.4 Third-party laboratory testing should be employed for secondary verification.

4.3.5 Instrumental chemical composition analysis includes the steps in 4.3.6.1 through 4.3.6.4.

4.3.5.1 For sorption and mimic aids, the chemical(s) present in the headspace shall be characterized (Figure 2a).

4.3.5.2 For sorption and mimic aids, the chemical(s) present in the solid and liquid phases should be characterized (Figure 2b).

4.3.5.3 For dilution aid or if alternative training aid type is unknown, the chemical(s) present in the headspace shall be characterized (Figure 2a).

4.3.5.4 For dilution aid or if alternative training aid type is unknown chemical(s) present in the solid or liquid phases shall be characterized (Figure 2b).

4.3.6 Secondary verification shall be performed as often as necessary to ensure consistency across lots and shall be part of the manufacturing's quality control and standard operating procedure (SOP).

4.3.6.1 The secondary verification SOP shall be documented prior to use.

4.3.6.2 The secondary verification SOP shall specify the type of samples to be tested, the frequency of monitoring, acceptable analyte amounts (as defined during primary verification) and reproducibility, and background characterization.

4.3.6.3 Actions to take in the event of deviations from the prescribed parameters should be documented prior to SOP implementation and the revised SOP should be made available for the end user upon request without requirement of purchase.

NOTE See ISO 9000 as an example of guidance for quality management[7].

4.3.7 Secondary verification testing results shall be documented.

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4.4 Characterization of the Chemicals Present in the Headspace (see Figure 2a)

4.4.1 At a minimum, headspace compounds shall be collected by static or dynamic headspace sampling.

4.4.1.1 The extracted headspace sample shall be characterized using gas chromatography-mass spectrometry (GC/MS) or gas chromatography-electron capture detection (GC/ECD). Sampling techniques should include solid-phase microextraction (SPME) fibers or thermal desorption tubes.

4.4.1.2 Thermal desorption should be used for introducing the extracted headspace sample into the analytical instrument.

4.4.1.3 If thermal degradation from the desorption process is a concern, then the sample should be eluted from the SPME fibers or sorbent tubes using solvent extraction.

4.4.2 Blank training aids (e.g., negative control) shall be prepared and analyzed in the same manner for evaluating interfering or inherent background compounds (e.g., nontarget compounds from the blank training aid substrate).

4.4.3 At least three separate replicate samples, of the training aid material and blanks, shall be characterized.

4.4.3.2 If available, replicate samples should be obtained from different samples in the same lot.

NOTE If that is not feasible due to the limited number of aids available, triplicate measurements may be taken of a single aid and reported as such.

4.4.4 Many techniques, such as direct headspace analysis using mass spectrometry or proton transfer reaction mass spectrometry, may be used to complement, but shall not replace the method described in 4.4.1.

4.5 Characterization of the Chemicals Present in the Solid or Liquid Phase (see Figure 2b)

4.5.1 The solid or liquid training aid shall be characterized using chromatography coupled with a detector (e.g., GC/MS, GC/ECD, liquid chromatography-mass spectrometry [LC/MS], liquid chromatography-ultraviolet spectroscopy [LC/UV]).

4.5.1.2 For sampling solid-phase materials, the sample shall be subjected to solvent extraction and analysis.

4.5.1.3 For sampling liquid-phase materials, the sample shall be subjected to solvent extraction, dilution of the original liquid material, or analysis of the neat material (i.e., not diluted or mixed with any other substance) by direct immersion SPME or direct injection.

4.5.1.4 The extract generated in either 4.5.1.2 or 4.5.1.3 should be analyzed using direct injection or immersion SPME.

4.5.2 Blank training aids (i.e., negative control), if available, shall be prepared and analyzed in the same manner for evaluating interfering background compounds (i.e., nontarget compounds from the blank training aid substrate).

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4.5.3 At least three separate replicate samples, of the training aid material and blanks, shall be characterized.

4.5.3.2 If available, replicate samples should be obtained from different samples in the same lot.

NOTE If that is not feasible due to limited number of aids available, triplicate samples may be taken from a single training aid.

4.6 Canine Odor Recognition Assessment (see Figure 3)

NOTE The canine odor recognition assessment is testing the training aid and not the canine.

4.6.1 Canine testing for primary verification shall include both true and alternative training aid detection canines[10] (Table 2).

Table 2—Primary Verification: Canine Testing Groups and Personnel

Canine Testing Groups or Personnel	Role	Comment
True training adi detection canine/group	Canine(s) trained in the detection of the odor emanating from a true material and certified or otherwise shown to be proficient in its detection.	For verifying alternative training aids, these canines are trained on the true material(s) prior to being used for training aid assessment. This type of canine is also known as a "true canine".
Alternative training aid detection canine/group	A canine(s) that has not previously been trained to or have known incidental exposure to the target odor related to the training aid being verified.	For verifying alternative training aids, these canines are trained on the alternative training aid. This type of canine is also known as a "true canine".
Canine team training personnel	Trains canines in preparation for assessment	May also be the canine canine operator
Data recorder	Records canine or canine operator team response or other canine behavior data, during an odor recognition assessment	May also be the test administrator
Test administrator	Administers an odor recognition assessment	May set up an assessment or provide feedback on canine operator indications. May also be the data recorder.
Canine operator	Anyone who handles a canine.	May not have the full training and certification associated with an operational canine handler, but does have training in the handling a canine in a safe and appropriate manner. May also be the canine team training personnel .

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4.6.1.2 The true training aid detection canines shall have been trained in the detection of the target odor using the true material and have been certified or otherwise proven to be proficient in its detection prior to the assessment.

4.6.1.3 The true training aid detection canines shall not have been previously trained to or have known incidental exposure to the alternative training aid.

4.6.1.4 The alternative training aid detection canines shall not have been previously trained to or have known incidental exposure to the target odor related to the training aid being verified.

4.6.1.5 Detection canine groups should be selected based on criteria described in ANSI/ASB Std 085, *Standard for Detection Canine Selection, Kenneling and Healthcare*.

NOTE The canine selection criteria as described in ANSI/ASB Std 085 may be modified as the testing protocols require.

4.6.1.6 Detection canine groups shall be trained by a canine team training personnel (see Table 2) to meet the same criteria prior to testing.

4.6.1.7 The testing shall be set up and performed in an identical manner for both the true and alternative training aid canine groups.

NOTE The two canine groups may be tested during the same odor recognition assessment or on separate occasions.

4.6.1.8 The true and alternative training aid groups shall complete a baseline capability assessment prior to completing the generalization assessment toward the alternative training aids or the true materials.

NOTE In a baseline test, samples refer to trained target materials. In a generalization test, samples refer to untrained target materials. Baseline and generalization assessments should be under similar conditions.

4.6.2 The assessments shall demonstrate canine generalization proficiency and reproducibility of results between multiple canines towards replicate alternative training aids.

NOTE 1 For the true training aid group, baseline capability assessment is the proficiency of the canine team to locate the true material that the canine has not previously encountered during training, and the generalization assessment is the proficiency of the canine team to locate the alternative training aids.

NOTE 2 For the alternative training aid group, baseline capability assessment is the proficiency of the canine team to locate the alternative training aid that the canine has not previously encountered during training, and the generalization assessment is the proficiency of the canine team to locate the true material.

4.6.3 The assessments consist of components and parameters for operational or non-operational odor recognition assessments, as outlined in 4.6.3.1 through 4.6.3.7.

4.6.3.1 The number of canines shall be at least 5 for each group (True Training Aid Detection and Alternative Training Aid Detection group).

4.6.3.2 An odor recognition assessment shall be made up of individual searches.

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4.6.3.3 Each search shall include target odors and non-target odors (e.g., distractors and blanks) placed in dedicated containers.

NOTE An exception is a blank search where no target odor is present.

4.6.3.4 An odor recognition assessment shall include the following:

a) at least 3 replicate target odors (i.e., samples);

b) non-targets in excess of targets;

c) distractors, including items used in testing (gloves, wipes, substrates, markers, etc.) as well as other non-target odors (lotions, soaps, foods, crayons, plastics, etc.);

d) handling and containment of distractors in an identical manner to the target odors;

e) blank training aids (e.g., negative control), which include any containment or substrate used within or with the target odors;

f) blank containers (i.e., empty containers);

g) randomized order of targets, distractors and blanks in a search (e.g., using a random number generator or dice);

h) at least one search where all samples are distractors (i.e., blank runs);

i) all identical containers:

1) multi-use containers made of a non-porous material (e.g., metal, glass, or PVC), or single-use made of porous material (e.g., cardboard, or paper);

2) all samples (targets, distractors and blanks) placed undisturbed within a container to provide time to equilibrate;

NOTE A minimum time of 30 minutes is commonly used.

3) hide placements of equal difficulty and access for all samples to include targets and controls;

j) target materials handled and stored in such a way to minimize cross-contamination:

1) following provided manufacturer guidelines for storage;

2) stored at room temperature or below, when the manufacturer does not provide storage guidelines; and

NOTE Ideally, a containment system consisting of two or more layers is used: a primary containment layer and a secondary containment layer. For example, a metalized or odor-reducing bag can be used as a primary containment layer, while a canning jar, or the like, can be used as a secondary containment layer.[5,10]

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k) sample containers placed in a location that minimizes environmental influences that may affect the odor;

4.6.3.5 Location of testing (e.g., indoors or outdoors) shall be recorded.

4.6.3.6 The environmental conditions, including temperature and humidity, should be recorded.

4.6.3.7 The assessment shall be at a minimum single-blind.

4.6.3.7.1 The assessment should be conducted and reported as double-blind whenever possible.

NOTE It is best practice for each search in the assessment to remain double-blind until the canine operator calls the outcome (ex. calls an "alert"), and then the test administrator can indicate whether the outcome is correct.

4.6.4 Data shall be collected to calculate the accuracy rates for both the baseline and generalization assessments.

4.6.4.1 Data collected to calculate the accuracy rate for the generalization assessment shall include:

a) any alerts to the untrained target that occur prior to reinforcement to that target; and

b) any alerts to the untrained target that occur before the canine has been reinforced for a third time to that target (i.e., three reinforced correct alerts).

4.6.4.2 The data recorder and the canine operator shall ensure the canine searches each container in a consistent manner.

4.6.4.2.1 When a data recorder independently records canine behavior data separate from the blind canine operator response, they shall be blind to the test setup.

NOTE In this scenario, the data recorder may be in the room of the assessment.

4.6.4.2.2 When a data recorder is capturing the blind canine operator response (ex. canine operator calls "alert"), and is aware of the placement of the items in the test, they shall be removed from the room of the assessment for a double-blind assessment.

4.6.4.3 Data shall not be collected for any canine alerts after the canine has been reinforced to the untrained target three times.

NOTE The canine reward frequency may be based on the preferences of the test administrator and canine canine operator.

4.6.4.4 If more than one pass is completed, the data recorder should notate responses to the first pass separately from each subsequent pass.

4.6.5 In addition to the true and alternative training aid detection canines, the personnel that should be involved in the assessment are included in Table 2.

NOTE Automation may negate the need for some of the listed personnel.

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5 Reporting

5.1 General

5.1.1 The end user should request primary and secondary verification report(s) to ensure claims from the manufacturer.

NOTE 1 The output from the verification of alternative training aids is a report. The report provides the results from instrumental chemical composition analysis (solid or liquid and headspace analysis) and canine training aid assessment. The report provides transparency about the testing that was carried out.

NOTE 2 The report informs the end-user of the chemical composition of the vapor and of the solid or liquid phase of the training aid (see Figure 2a and Figure 2b).

NOTE 3 The report gives the odor recognition assessment parameters and outcomes for both the baseline and generalization assessments of the training aid.

5.1.2 Purchase of the training aid shall not be required for access to primary and secondary verification reports.

5.2 Report for Characterization of Chemicals Present in the Headspace (Figure 2a; Section 4.4)

5.2.1 The following information shall be included:

a) date of analysis and the number of sample replicates that were characterized;

b) form factor (e.g., qualitative descriptions of the substrate material, color, hardness, etc., and packaging form);

c) starting mass of the training aid being tested, measured with a precision of at least 0.1 g;

d) any sample manipulation (e.g., subsampling or repackaging);

e) the manufacturing date of material being tested, the associated lot numbers, and age of original or raw source material, if known (e.g., real explosive materials for sorption aids or chemicals for mimic aids) when available;

f) alternative training aid target compounds, if previously established (e.g., Dinitrotoluene for TNT), and references or rationale for how targeted compounds were chosen.

5.2.2 The following information should be included:

a) Headspace extraction method (e.g., SPME, thermal desorption tube, etc.) including details of the method as appropriate, such as:

   1) type of substrate or substrate coating (polydimethylsiloxane for SPME, Tenax for thermal desorption, etc.);

   2) extraction and equilibration temperature, time, and volume;

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3) volume of the sample container in which the headspace vapor sampling takes place (e.g., 1 gallon paint can, sampling vial) and whether the container is sealed or opened;

4) analytical instrumentation parameters (e.g., GC/MS methods such as temperature ramping, separation time, mass spectral scan range, and make and model of the instrument);

5) other experimental information and observations deemed pertinent by the analyst;

6) any internal or external chemical standards used.

b) A table of data for target compounds and other detected analytes that should include:

1) peak retention times of major analytes, defined as peaks with area greater than 5% of the most abundant peak in the chromatogram, excluding peaks associated with column bleed or the SPME fiber;

2) compound names or identifier determined by one of the following;

i) calibration standards,

ii) library matching software (including confidence score),

iii) retention time and fragment ion figures for compounds having poor library matches and not contained within the calibration standards;

3) the integrated peak areas or ratio of peak area to internal standard if used;

4) if semi-quantitative measurements are made using calibration curves, descriptions of the calibration curve shall be reported, including:

i) linear regression equation for the quantified compounds,

ii) correlation coefficient (R^2) values,

iii) minimum quantifiable figures of merit, e.g., minimum detection limits.

c) Raw data (chromatograms, spectra, etc.) pertaining to each training aid and blank in an appendix.

5.2.3 The information in 5.2.2 shall be made available upon request without a requirement of purchase if it is not included in the report.

5.3 Report for Chemical Composition of the Targets in the Solid or Liquid Phase (Figure 2b; Section 4.5)

5.3.1 The following information shall be included:

a) date of analysis and the number of replicates that were characterized;

b) form factor (e.g., qualitative descriptions of the substrate material, color, hardness, etc., and packaging form);

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c) starting mass of the training aid being tested, measured with a precision of at least 0.1 g;

d) any sample manipulation (e.g., subsampling or repackaging);

e) the manufacturing date of material being tested, the associated lot numbers, and age of original/raw source material, if known (e.g., real explosive materials for sorption aids or chemicals for mimic aids) when available;

f) alternative training aid target compounds, if previously established (e.g., TNT or Dinitrotoluene for TNT), and references or rationale for the how targeted compounds were chosen;

5.3.2 The following information should be included:

a) Extraction method (e.g., solvent extraction) including:

1) type of solvent or other extraction medium used (e.g., methanol);

2) extraction temperature, time, solvent volume, use of agitation, or method of concentration, as applicable;

3) analytical instrumentation parameters (e.g., GC/MS methods such as temperature ramping, separation time, mass spectral scan range, and make and model of the instrument);

4) other experimental information and observations deemed pertinent by the analyst;

5) any internal or external chemical standards being used.

b) A table of data for target compounds and other detected analytes that should include:

1) peak retention times of major analytes, defined as peaks with area greater than 5% of the most abundant peak in the chromatogram, excluding peaks associated with column bleed;

2) compound names or identifier determined by one of the following:

i) calibration standards,

ii) library matching software (including confidence score),

iii) retention time and fragment ion figures for compounds having poor library matches and not contained within the calibration standards;

3) the integrated peak areas for all compounds in the table as well as the concentration of the targeted analytes as determined by comparison to a calibration curve;

4) calibration curves, descriptions of the calibration curve shall be reported, including:

i) linear regression equation for the quantified compounds;

ii) correlation coefficient (R^2) values;

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iii) minimum quantifiable figures of merit, e.g., or chemical analysis methods, reporting minimum detection limits;

c) Raw data (chromatograms, spectra, etc.) pertaining to each training aid and blank in an appendix.

5.3.3 The information in 5.3.2 shall be made available upon request without a requirement of purchase if it is not included in the report.

5.4 Report for the Canine Odor Recognition Assessment (Figure 3, Section 4.6)

5.4.1 The report for the canine odor recognition assessment shall include the following information:

a) date of assessment and number of sample replicates assessed;

b) form factor (e.g., qualitative descriptions of the substrate material, color, hardness, etc., and packaging form);

c) starting mass of the training aid being tested, measured with a precision of at least 0.1 g;

d) any sample manipulation (e.g., subsampling or repackaging);

e) the manufacturing date of material being tested, the associated lot numbers, and age of original/raw source material, if known (e.g., real explosive materials for sorption aids or chemicals for mimic aids) when available; and

f) testing results, including:

1) total number of canines in the alternative and true groups;

2) total number and percentage of true responses to true material separately for each type of assessment (baseline and generalization);

3) total number and percentage of true responses to alternative training aids in question separately for each type of assessment (baseline and generalization); and

4) total number and percentage of false responses separately for blanks and distractors for each type of assessment (baseline and generalization).

5.4.2 The following information should be included:

a) information regarding the test set-up, including:

1) number of canines used in the test, their age in years, and the prior experience of the canines and canine operators with the target being tested and certifications, if any;

2) number and type of blanks, distractors, and targets; and

3) descriptions of the assessment searches (e.g., odor recognition assessment vs. odor recognition in operational context);

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b) environmental conditions during the assessment; and

c) all types of containment used.

NOTE Additional information regarding test design, such as reinforcement schedule, type, and order of blanks, distractors, and targets may be included in the report.

5.4.3 The information in 5.4.2 shall be made available upon request without a requirement of purchase if it is not included in the report.

5.4.4 If a shelf-life or service-life is determined, the test conditions used during these analyses, including containment and storage conditions, shall be included.

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Annex A
(informative)

Types and Definitions of Detection Canine Training Aids[5,9,14]

Type of Aid	Definition	Example/Notes
Alternative Training Aid	Any type of training material that does not use target material as ordinarily encountered by detection canine while deployed; commonly used in the cases where the true material is hazardous, has limited availability, or controlled access.	Overarching term; subclassifications include Sorption, Mimic, and Dilution.
Mimic Aid	Chemical selected with the goal of imitating the real odor of a target material.	Commonly referred to as "pseudo" or "surrogate" aid
Sorption Aid	Sorption of gas-phase compounds from the targeted material could be sorption from true material or from another "alternative" training aid.	Commonly referred to as "soaks"; may be homemade, such as a cotton ball placed near the training aid to "soak" the odor, or may be purchased commercially
Dilution Aid	Liquid- or solid-phase target material added to or encapsulated into a substrate in order to render the target material non-hazardous.	Most commonly used with explosives to render them non-detonable.
Performance Maintaining Training Aid (PMTA) (see NOTE)	An additional target odor that is not related to the canines' training samples and is not otherwise likely to be found in the search environment.	Detection performance can be evaluated or maintained by allowing for canines to find and indicate on a PMTA, such as when access or use of real material is limited. ex. inert plastic explosive (IPE)[4], universal detector calibrant (UDC)[12]

NOTE PMTA are not discussed in the main body of this document; however, it is included in this table for educational purposes[4].

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Annex B
(informative)

Example Test Plan for the Development and Verification of an Alternative Training Aid

The workflow outlined below is to assist persons developing new training aids. There are several steps outside the scope of the attached standard that ideally need to occur before training aid verification to ensure that an efficacious training aid is being developed (see Figure B.1). Alternative training aids that have been on the market have likely gone through several of the steps but will likely need to be verified before operational use. This test plan is solely meant as an example minimum workflow; training aid developers may add additional steps, deviations, or iterations to this example to ensure they are bringing a suitable alternative training aid to the market.

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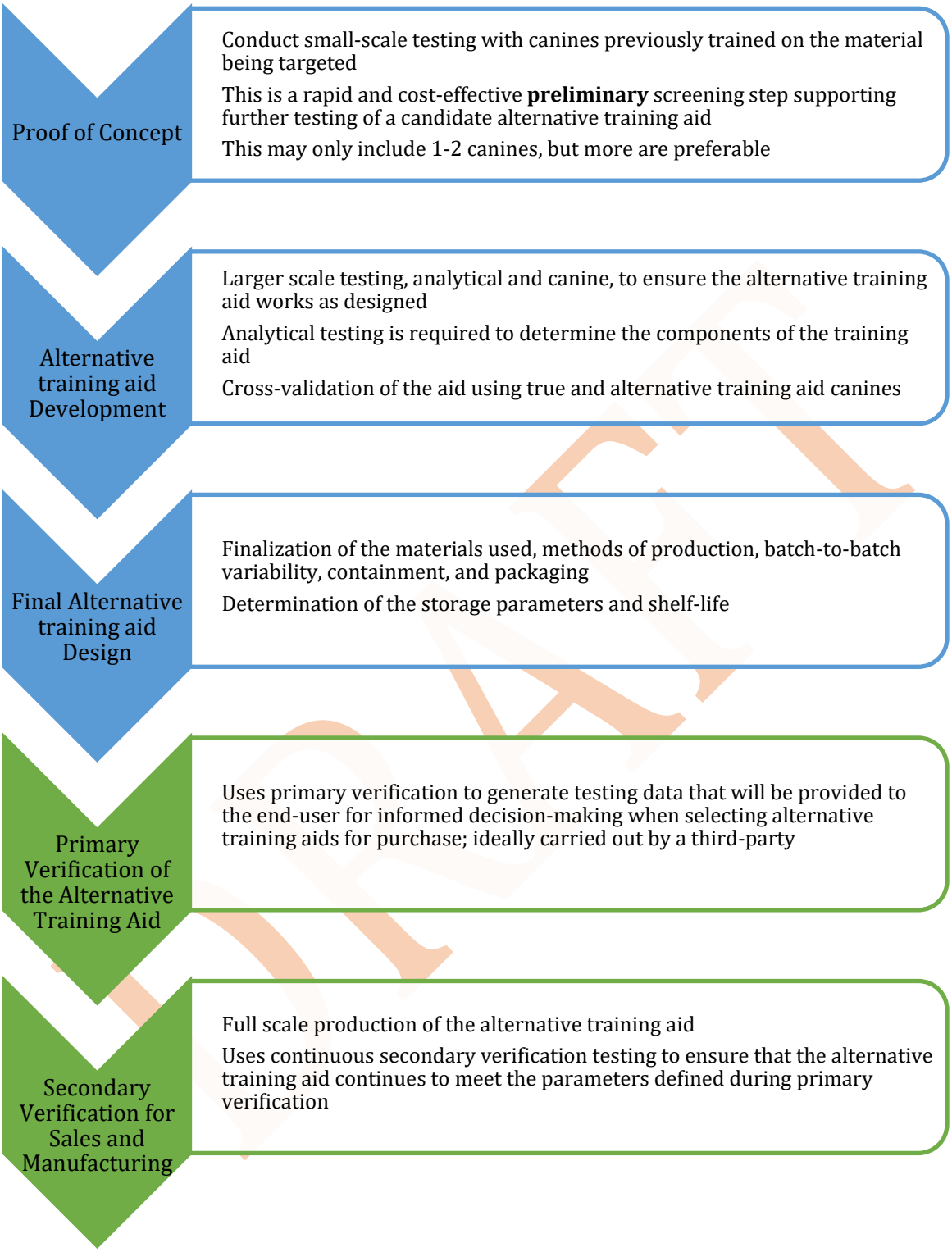


Figure B.1—Example Test Plan for the Development and Verification of an Alternative Training Aid. Steps colored in green are covered in this Standard.

Annex C
(informative)

Training Aid Readiness Level (TARL) Based on Current Knowledge of Canine Detection Odorants

The training aid readiness level (TARL) is defined as the degree of foundational research and development relating to both canine testing and instrumental analysis for the verification and deployment of a canine detection training aid. The TARLs are based on verification levels in Table 1 from the document and Table C.1.

Table C.1—Testing Standard Table

Level of research conducted and acceptance by scientific community	***Category***	
	Canine testing	***Chemical analysis***
Element 1	Some canine testing that does not meet all requirements in the document	Some chemical testing that does not meet all requirements in the document
Element 2	Canine testing completed according to primary verification requirements in the document	Chemical testing completed according to primary verification requirements in the document
Element 3	Peer-reviewed data available OR replicative study available	Peer-reviewed data available OR replicative study available

Table C.2—Training Aid Readiness Levels

Level	***Requirements***
TARL 1	One category with an Element 1
TARL 2	One category with an Element 1 paired with an Element 3 in the same category
TARL 3	Both categories with an Element 1 OR one category with an Element 2
TARL 4	One category with an Element 2 paired with an Element 3 in the same category
TARL 5	One category with an Element 1 and the other category with an Element 2
TARL 6	One category with an Element 1 AND the other with an Element 2. One category must include an Element 3
TARL 7	Both categories with an Element 2
TARL 8	Both categories with an Element 2, AND one category is also paired with an Element 3
TARL 9	Both categories with an Element 2 AND both are paired with an Element 3
TARL 10	Both categories with an Element 2 AND both are paired with an Element 3. Must be carried out by a third-party with associated data available to the public in the form of a peer-reviewed article or official report.

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Annex D
(informative)

Bibliography

The following bibliography is not intended to be an all-inclusive list, review, or endorsement of literature on this topic. The goal of the bibliography is to provide examples of publications addressed in the standard.

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