OSAC PROPOSED STANDARD 2024-S-0023

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

Dogs & Sensors Subcommittee
Scene Scientific Area Committee (SAC)
Organization of Scientific Area Committees (OSAC) for Forensic Science

OSAC Proposed Standard

OSAC 2024-S-0023
Standard for the Systematic Verification of Alternative Training Aids for Detection Canine Disciplines

Prepared by
Dogs & Sensors Subcommittee
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Version No.	Issue Date	Section	Reason
2.0	October 7, 2025	--	Added to the OSAC Registry and publicly announced.
2.1	January 13, 2026	4.6.5	Removed ANSI designation from a Reference.

Table of Contents

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

1 Scope

Within the detection canine discipline, situations may preclude using true materials to train and so, it is imperative that any training materials meet the standards set forth in this document. This is essential to protect the safety and efficacy of training for working canine teams. As such, it is vital to have verified alternative training aid materials for odor recognition training. Verification requires both chemical composition characterization and testing via canine assessments. The combination of these tests will improve manufacturing quality, confirm training aid utility for generating and maintaining canine team operational proficiency, and inform end-users with training aid selection.

This Standard serves as a foundational document with requirements for conducting verification tests. It is not intended as a detailed description of chemical analysis and canine assessment methodologies, which will be included in separate standards. The principles of good laboratory practice and record keeping will be applied to the concepts in this document.

1.1 This standard addresses verification of alternative training aids for detection canines by both analytical methods and canine testing.

1.2 This standard describes a systematic process for assessing alternative training aids, including the instrumental chemical composition analysis (solid/liquid and headspace analysis) and canine training efficacy.

1.3 This standard is applicable to and defines categories of alternative training aids for detection canines.

1.4 This standard should be utlized by training aid manufacturers or manufacturer-contracted laboratories, but may also be used by other interested parties

1.5 The intent of this document is to provide the canine community 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.

1.6 Verification, both primary and secondary, provide feedback to both the canine community, as well as the producer when verification tests are completed by a third party.

1.7 Verification assesses the strengths and limitations of training aid(s) resulting in reliable and scientifically supported recommendations for use.

1.8 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.

1.9 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.

1.10 Current canine training aid verification research efforts do not use the same statistical rigor found in many scientific fields, like analytical chemistry measurements. This issue is due in part to the difficulty in recruiting a sufficient number of odor detection canines and handlers and/or a sufficient number of detection canines with the proper threat signature training. In addition, some studies require that canines must be tested on odors they have not previously encountered, which can be both difficult to recruit/procure and costly to kennel and train. As a result, the canine sample size may be too small to calculate any statistically based conclusions. A full 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].

1.11 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.

2 Normative References

There are no normative reference documents.

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, First Edition, 2017 for a comprehensive listing of detailed general detection canine 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; commonly used in the cases where the true material is hazardous, has limited availability, or controlled access; subclassifications include, Sorption, Mimic, Dilution, and Performance Maintaining Training Aid (PMTA).

3.2
alternative training aid detection canine/group (i.e. alternative canine/group)
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.

3.3
baseline capability assessment
An odor recognition assessment test that evaluates a canine's response to target materials. In the case of training aid verification, for the true training aid group, the baseline capability assessment tests the proficiency of the canine team to locate the true material, and for the alternative training aid group, the baseline capability assessment tests the proficiency of the canine team to locate the alternative training aid.

3.4
blank
Any area or container where target odor is not present (Canine testing definition). (see blank search)

A control where a specified component(s) is not present (Instrumental definition).
Discussion. 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.

3.5
blank search
A search exercise (training, certification, testing, etc.) in which the target odor is not present.

3.6
blank training aid
A training aid composed of all the training aid materials except the target compound(s), such as substrate, containment, solvent, etc. The blank training aid has undergone all of the same manufacturing procedures as the training aid. Also known as negative control.

3.7
canine handler
A person responsible for recognizing the behavior of the detection canine. The person is also responsible for completing a course of canine handling in their specific discipline, care for canine

(housing, husbandry, etc.), and maintains those abilities through field applications, maintenance training, certification, recertification and agency or program required continuing canine education.

3.8
canine team
A human and working canine that train and work together as an operational unit.

3.9
canine trainer
A person responsible for training canines and canine handlers. This person performs the maintenance training and proficiency training in the field, and train canines in preparation for a formal course of instruction.

3.10
chromatographic feature
A peak observed in a chromatogram that is indicative of the elution of an analyte following chromatographic separation (see gas chromatography or liquid chromatography).

3.11
containment systems
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.

3.12
data recorder
Personnel involved in recording the canine/handler team response or other canine behavior data, such as change of behavior, during an odor recognition assessment.

3.13
dilution aid
Liquid- or solid-phase target material added to or encapsulated into a substrate to render the target material non-hazardous.

3.14
distractor
Non-target stimuli placed or present within a search area. These can include: human scent, toy, food or animal odor, or non-target odorous chemical etc.

3.15
double-blind

In the evaluation of a canine team, neither the experimenter, assessor, data recorder, the canine handler, nor any persons visually accessible to the canine team knows the location or identity of the target odor or whether target odor is present (e.g., a blank/null search) or the assessor is not in a position to influence the outcome (i.e., two-way glass, video monitoring, physical barriers, great distance).

3.16
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 medium through applied positive or negative pressure.

3.17
false positive
A response indicating that something is true or present when it is not true or absent. Scientific usage: Type 1 error.

3.18
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 (GC) coupled with a detection technique (electron capture detection)**.**

3.19
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 (GC) coupled with a detection technique (mass spectrometry).

3.20
generalization
The tendency to respond to a class of stimuli that share some common characteristics (e.g., the presence of some compound) and that may vary across some other dimension known or unknown (e.g., a concentration gradient) rather than only to the one which was originally conditioned.

3.21
generalization assessment
An odor recognition assessment that tests a canine's response to untrained target materials following specific training on related target materials. 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.

3.22
headspace
The vapor emanating from a specific source of interest.

3.23
headspace analysis
Practice for sampling and analyzing the headspace.

3.24
linear regression
Consists of finding the best-fit linear relationship between the instrument response (Y) and the concentration of the analyte in the calibrator (X).

3.25
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 (LC) coupled with a detection technique (mass spectrometry).

3.26
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 (LC) coupled with a detection technique (ultraviolet spectroscopy).

3.27
mimic aid
Chemical(s) selected with the goal of imitating the real odor of a target material. In addition to the targeted chemicals, the aid may include a substrate material.

3.28
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). This layer is responsible for physically containing the substance and preventing it from leaking, spilling, or emitting odors prematurely. This could be a variety of materials (e.g. plastic bag, linen bag, glass vial, etc).

3.29
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. 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

3.30
service life
The period of time for which the training aid is in routine operational use and maintains its efficacy.

3.31
shelf life
The period of time during which a training aid may be stored and maintains its efficacy.

3.32
single blind
Scientific usage: This condition occurs when the canine handler does not know which treatments/manipulations are given to which subjects. Operational usage: In the evaluation of a canine team's ability to detect the target odor; the data recorder, observer, assessor, certifying official, or evaluator know the location of the target odor or whether target odor is present (i.e., a blank/null search), and the canine handler does not.

3.33
static headspace sampling
An extraction technique in which a portion of the headspace vapor is removed from the sample container without use of positive/negative pressure.

3.34
solid-phase microextraction (SPME)
An extraction technique where the analytes from a sample are adsorbed onto a fiber coated with an adsorptive medium and thermally desorbed into the injection port of the instrument.

3.35
solvent extraction
The transfer of chemical compounds from a material to a solvent.

3.36
sorbent tubes
A sample-collection device in which the sample vapor is pumped into tubes packed with one or more sorbents.

3.37
sorption aid

Sorption of vapor-phase compounds from the targeted material(s), could be sorption from true material(s) or from another “alternative” training aid.

Note. Sorption aids are commonly referred to as “odor soaks”.
Note. Physical transfer of a liquid or solid target material onto a substrate is considered a dilution aid (see 3.13 Dilution aid).

3.38
target
The odor for which the canine is trained to respond.

3.39
test administrator
Personnel involved in administering an odor recognition assessment. This person(s) may set-up assessment and/or provide feedback on handler indications.

3.40
thermal desorption
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.

3.41
thermal desorption tube
A sample-collection device in which the sample vapor is pumped through applied positive or negative pressure into tubes packed with one or more sorbents.

3.42
third-party testing
Independent testing by those not involved in the design and implementation of the training aid being tested and is not intended as the eventual operational user of that training aid.

3.42
training aid
Target odor source(s) used for training, assessments, certification, maintenance training, and proficiency testing. This could be true or alternative training aid(s).

3.43
training aid characterization
The process of identifying the chemical components of a training aid.

3.44
training aid primary verification

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

3.45
training aid readiness level (TARL)
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 Appendix C for detailed description.

3.46
training aid 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.

3.47
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). To be distinguished from alternative training aids.

3.48
true training aid detection canine/group (i.e. true canine/group)
Canine(s) trained in the detection of the odor emanating from the true material(s) 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.

4 Requirements

4.1 Overview

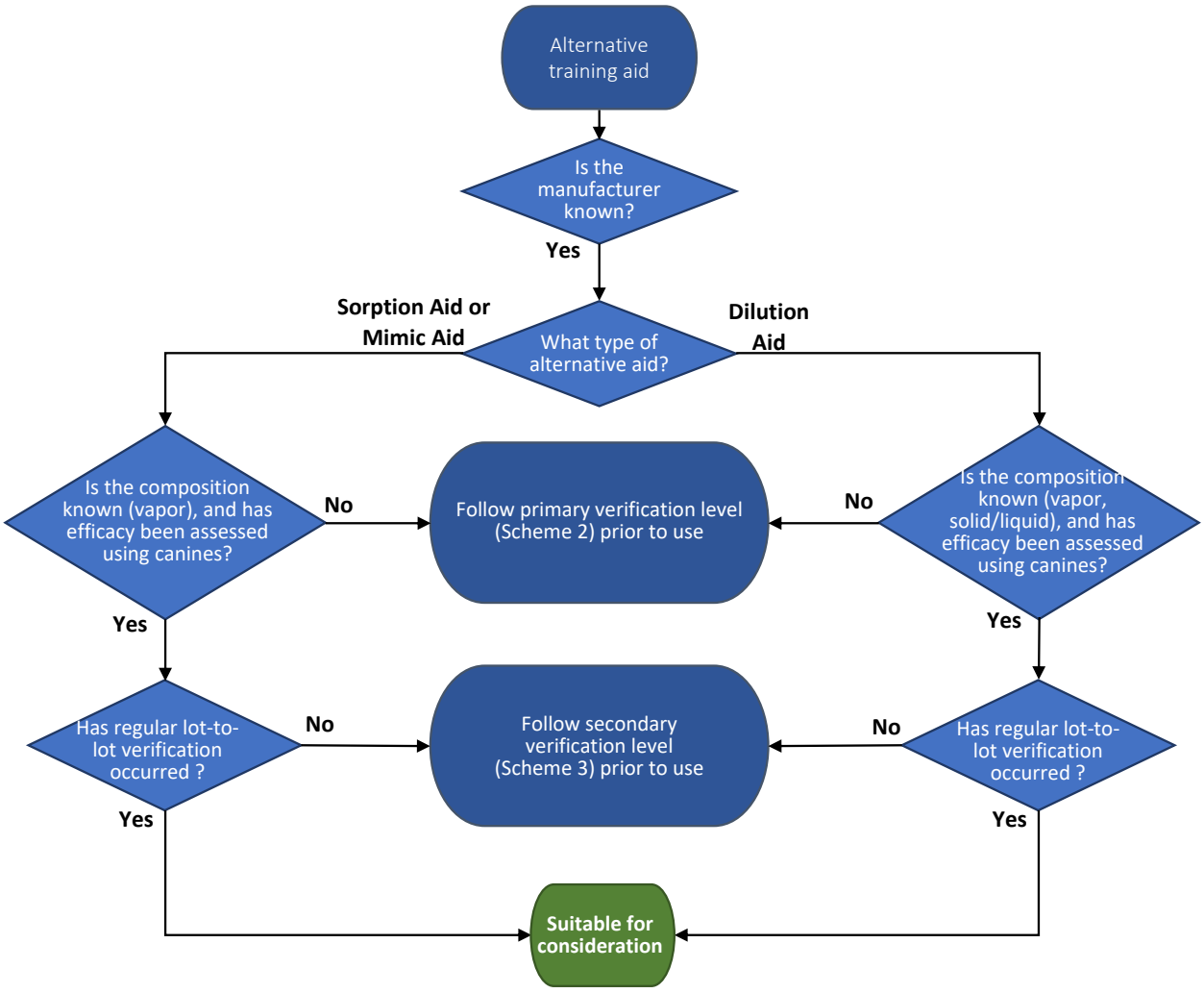
4.1.1 Table 1 and Scheme 1 describe the minimum primary verification level for newly developed or previously untested aids and the minimum secondary verification level for regular production testing after primary verification has occurred.

Note. Characterizing the shelf-life is also recommended as a part of primary verification.

Table 1. Assessment of training aids

Primary verification level (newly developed or previously untested training aids)	Secondary verification level (production testing)
Solid/liquid analysis	Headspace analysis (preferred)

Headspace analysis Canine testing	And/or Solid/liquid analysis



Scheme 1. Assessment of a training aid.

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

4.1.3 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.

4.1.4 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 below.

Note. This standard is intended to be carried out in an analytical laboratory with established ISO17025 accreditation or documented compliance, or its equivalent accreditation, and with the proper space, equipment, and personnel to carry out the procedures described herein.

4.1.5 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.

4.1.6 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 below and conducted using protocols that have been approved by a governing body, such as an Institutional Animal Care and Use Committee (IACUC), as appropriate.

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

4.2 Primary verification level:

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

4.2.2 The results of primary verification shall define the parameters to be met by future secondary verifications. Acceptable deviations from primary verification results shall be defined prior to secondary verification.

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

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

4.2.4 Instrumental chemical composition analysis includes:

4.2.4.1 For sorption and mimic aids, the chemicals present in the headspace shall be characterized (Scheme 2a), and the chemicals present in the solid and liquid phases should be characterized (Scheme 2b)

4.2.4.2 For dilution aids, the chemical(s) present in the headspace (Scheme 2a) and chemical(s) present in the solid or liquid phases (Scheme 2b) shall be characterized.

4.2.5 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 as well as detection canines (true group) that have been trained for the corresponding detection discipline (Scheme 3).

4.2.6 Primary verification testing results shall be documented and access to the report shall be available without requirement of purchase. (See Section 5)

4.3 Secondary verification:

4.3.1 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.

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

4.3.3 Secondary verification shall be conducted only after primary verification is complete.

4.3.4 Laboratory chemical characterization includes:

4.3.4.1 For sorption and mimic aids, the headspace shall be characterized (Scheme 2a), and the chemicals present in the solid and liquid phases should be characterized (Scheme 2b)

4.3.4.2 For dilution aids, the chemical(s) present in the headspace (Scheme 2a) and chemical(s) present in the solid or liquid phases (Scheme 2b) shall be characterized.

4.3.5 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).

4.3.5.1 The verification SOP shall be established prior to verification and shall specify, but not limited to, the type of samples to be tested, the frequency of monitoring, acceptable analyte amounts and reproducibility, and background characterization.

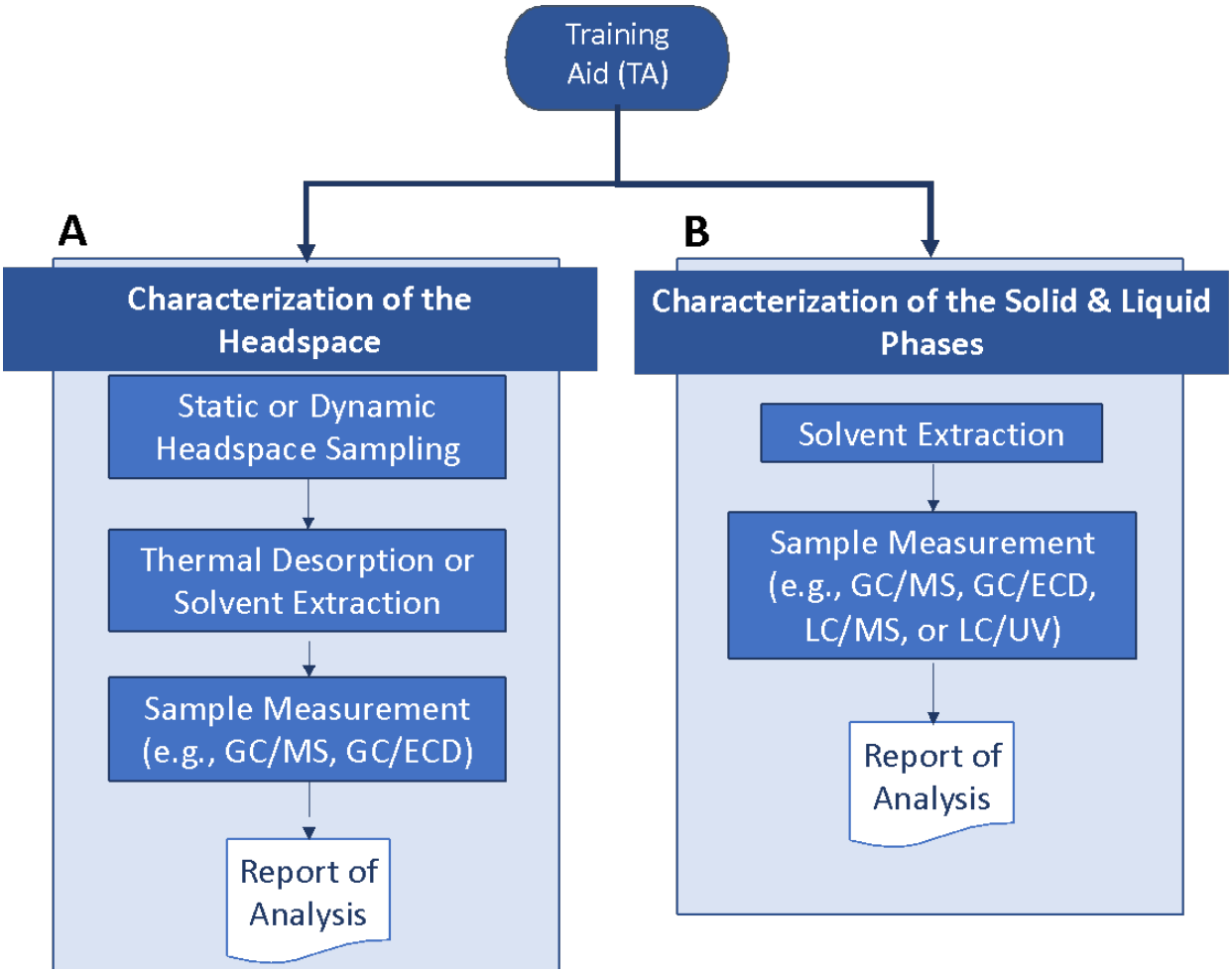
4.3.5.2 Actions to take in the event of deviations from the prescribed parameters should be documented prior to method implementation and made available for the end user upon request without requirement of purchase.

Note. See ISO9000 as an example of guidance.[1]

4.3.6 Secondary verification testing results shall be documented and access to the full report shall be available without requirement of purchase. (See Section 5).

4.4 Characterization of the chemicals present in the headspace (Scheme 2a)

[1] https://www.iso.org/standards/popular/iso-9000-family



Scheme 2. Characterization of the (A) headspace, and (B) solid and liquid phases.

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

4.4.2 For sampling the headspace, the sample will require collection of the vaporous compounds. At a minimum, headspace compounds shall be collected by static headspace sampling or dynamic headspace sampling.

4.4.3 Sampling techniques should include solid phase microextraction (SPME) fibers or thermal desorption tubes.

4.4.4 The extracted headspace sample shall be measured using GC/MS or GC/ECD.

4.4.4.1 Thermal desorption is recommended for introducing the extracted headspace sample into the analytical instrument. 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.

4.4.4.2 Blank SPME fibers and sorbent tubes shall be extracted similarly for assessing interfering background compounds (e.g., siloxane peaks from column or fiber coating).

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

4.4.6 At least three separate replicate samples, for the training aid material and blanks, shall be measured and reported. If available, replicate samples should be obtained from different samples in the same lot. If that is not feasible due to limited number of aids available, triplicate measurements may be taken of a single aid, and reported as such.

4.5 Chemical composition measurements of the targets in the solid or liquid phase (Scheme 2b)

4.5.1 Many techniques, such as Fourier transform infrared spectroscopy (FTIR) or direct analysis in real time (DART) mass spectrometry, may be used to complement, but not replace the method described below.

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

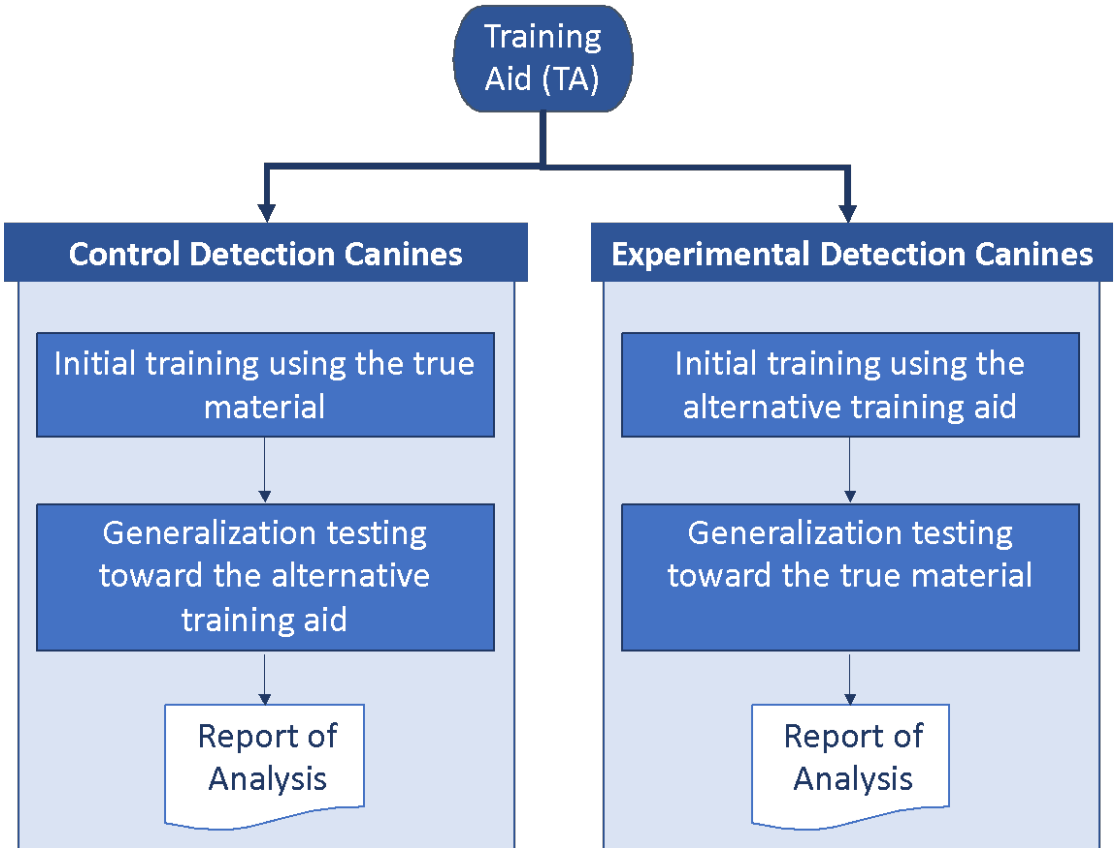
4.5.3 For sampling liquid phase materials, the sample shall be subjected to solvent extraction, dilution of the original liquid material, or analysis of the neat material by direct immersion SPME or direct injection.

4.5.4 The sample generated in either 4.5.2 or 4.5.3 should be analyzed using direct injection or immersion SPME with GC or LC separation and ECD or MS detection.

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

4.5.6 At least three separate replicate samples, including training aid material and blanks, shall be measured and reported. If available, replicate samples should be obtained from different samples in the same lot. If that is not feasible due to limited number of aids available, triplicate measurements may be taken of a single aid, and reported as such.

4.6 Canine odor recognition assessment (Scheme 3)



Scheme 3. Canine testing design for primary verification of an alternative training aid using true and alternative training aid detection canines/group.

4.6.1 Canine testing for primary verification shall include both true and alternative training aid detection canines[8].

4.6.1.1 The true training aid detection canines shall have been trained in the detection of the target odor using the true material(s) and have been certified or otherwise proven to be proficient in its detection prior to the assessment. They shall not have been previously trained to or have known incidental exposure to the alternative training aid.

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

4.6.1.3 Both detection canine groups shall 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.

4.6.1.4 Both detection canine groups shall be trained by a canine trainer (Table 2) using the same methods and oversight procedures or achieving the same criteria..

4.6.1.5 The true and alternative training aid groups may be tested during the same odor recognition assessment or on separate occasions, though the testing shall be set up and performed in identical manners.

4.6.1.6 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.

4.6.2 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.

Table 2. Assessment personnel

Assessment Personnel	**Role**	**Comment**
Canine trainer	Trains canines in preparation for assessment	May also be the canine handler
Data recorder(s)	Records canine/handler team response or other canine behavior data, during an odor recognition assessment	May also be the test administrator
Test administrator(s)	Administers an odor recognition assessment	May set-up assessment and/or provide feedback on handler indications. May also be the data recorder

4.6.3 The assessment(s) shall demonstrate canine generalization proficiency and reproducibility of results between multiple canines towards replicate alternative training aids.

4.6.4 The desired outcome of the search is the correct identification of the number and placement of the training aids by the canine team.

4.6.4.1 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.

4.6.4.2 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.

4.6.5 The assessment shall consist of the following components and parameters described in the discipline-related standards such as ANSI/ASB STD 092 *Standard for Training and Certification of Canine Detection of Explosives* and ASB STD 076 *Standard for Training and Certification of Canine Detection of Human Remains: Human Remains on Land*.

4.6.5.1 Canine testing for the primary verification of the alternative training aids shall include one or a series of odor recognition assessments.

4.6.5.1.1 An odor recognition assessment is made up of individual searches. Each search shall include target odors, distractors, and blanks placed in dedicated containers. An exception is a blank search where no target odor is present.

4.6.5.1.1.1 Distractors shall include items used in testing (gloves, wipes, substrates, markers, etc.) as well as other non-target odors (lotions, soaps, foods, crayons, plastics, etc.). Distractors shall be handled and contained in an identical manner to the target odors.

4.6.5.1.1.2 Blank training aids (e.g. negative control) which include any containment or substrate used within or with the target odors shall be used. Blank containers (i.e. empty containers) may be used in addition.

4.6.5.1.1.3 The order of targets, distractors and blanks in a search shall be randomized for each canine being tested, whenever possible.

Note. If a randomized approach is not used, document the reason why.

4.6.5.1.1.4 The session should include trials in which all samples are distractors (i.e. blank runs).

4.6.5.1.2 All target materials shall be handled and stored in such a way to minimize cross-contamination and manufacturer guidelines regarding storage shall be followed when provided. If the manufacturer does not provide storage guidelines, aids shall be stored at room temperature or below.

Note. Ideally, a containment system consisting of two or more layers are 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 [8,2].

4.6.5.2 The sample containers shall be placed in a location that minimizes environmental influences that may affect the odor.

Note. Hide placements should be of equal difficulty and access for all samples to include targets and controls.

4.6.5.3 The assessment shall be at minimum single-blind, but should be conducted double-blind whenever possible, and should be reported as such.

Note. It is best practice for each search in the assessment to remain double-blind until the handler calls the outcome (ex. calls an "alert"), and then the test administrator can indicate whether the outcome is correct. The canine reward frequency may be based on the preferences of the test administrator and canine handler. More details for designing non-, single-, and double-blind detection canine assessments will be covered in a separate standard which is currently under development.

Note. In the case the data recorder independently records canine behavior data separate from the blind handler response, they must be blind to the test set-up, but can be in the room of the assessment. If the data recorder is only capturing the blind handler response (ex. handler calls "alert"), then this person can be aware of the placement of the items in the test, but if they are, they must be removed from the room of the assessment for a double-blind assessment.

5 Reporting

The output from the verification of alternative training aids is a Report of Analysis. The Report of Analysis provides the assessment of alternative training aids, via defined results from instrumental chemical composition analysis (solid/liquid and headspace analysis) and canine training aid efficacy, and gives transparency about the testing that was carried out. This report should be requested from potential acquisition personnel for the end user to ensure verification of claims from the manufacturer and to ensure proper fit to end use. Purchase of the training aid shall not be required for access to the report.

For Schemes 2a and 2b (above in section 4.4), the Report of Analysis informs the end-user about the chemical composition of the vapor and solid or liquid phases. The target compounds and composition should be predefined in the test parameters and reported.

For Scheme 3, the Report of Analysis gives the odor recognition assessment parameters and outcomes for both the baseline and generalization assessments.

5.1 The Report of Analysis for characterization of chemicals present in the headspace (Scheme 2a; Section 4.4).

5.1.1 The following information shall be included:

5.1.1.1 Date of analysis and the number of replicates that were measured

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

5.1.1.3 Starting mass of the training aid being tested, measured with a precision of at least 0.1 g, and any sample manipulation (e.g., subsampling or repackaging).

5.1.1.4 The manufacturing date of material being tested and the associated lot numbers, when available.

Note. The manufacturer's best practice is to provide lot numbers, date of manufacture, and age of original/raw source material (e.g., real explosive materials for sorption aids or chemicals for mimic aids) for each training aid sold.

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

5.1.2 The following information should be included and shall be made available upon request without requirement of purchase:

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

5.1.2.1.1 Type of substrate or substrate coating (polydimethylsiloxane for SPME, Tenax for thermal desorption, etc.)

5.1.2.1.2 Extraction temperature, time, and/or volume

5.1.2.1.3 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

5.1.2.1.4 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)

5.1.2.1.5 Other experimental information and observations deemed pertinent by the analyst

5.1.2.1.6 Any internal or external chemical standards being used

5.1.2.2 A table of peak information for analytes detected including those other than the compounds being targeted for each sample. The table includes:

5.1.2.2.1 Peak retention times of major analytes, defined as peaks with area greater than 5% of the most abundant peak in the chromatogram

5.1.2.2.2 Compound names or identifier determined by one of the following;

5.1.2.2.2.1 Calibration standards

5.1.2.2.2.2 Library matching software (including confidence score)

5.1.2.2.2.3 Retention time and fragment ion figures for compounds having poor library matches and not contained within the calibration standards

5.1.2.2.3 The integrated peak areas or ratio of peak area to internal standard

5.1.2.2.4 If semi-quantitative measurements are attempted using calibration curves, descriptions of the calibration curve shall be reported, including

5.1.2.2.4.1 Linear regression equation for the quantified compounds

5.1.2.2.4.2 Correlation coefficient (R^2) values

5.1.2.2.4.3 Minimum quantifiable figures of merit, e.g., or chemical analysis methods, reporting minimum detection limits

5.1.2.3 Raw data (chromatograms, spectra, etc.) pertaining to each sample in an appendix

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

5.2 The Report of Analysis for chemical composition of the targets in the solid or liquid phase (Scheme 2b; Section 4.5)

5.2.1 The following information shall be included:

5.2.1.1 Date of analysis and the number of replicates that were measured

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

5.2.1.3 Starting mass of the training aid being tested and any sample manipulation (e.g., subsampling or repackaging).

5.2.1.4 The manufacturing date of material being tested and the associated lot numbers, when available.

Note. The manufacturer's best practice is to provide lot numbers, date of manufacture, and age of original/raw source material (e.g., real explosive materials for sorption aids or chemicals for

mimic aids) for each training aid sold.

5.2.1.5 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

5.2.1.6 Results of analysis including major analytes, defined as peaks with area greater than 5% of the most abundant peak in the chromatogram. No analyte below minimum quantifiable figures of merit (see 5.1.2.2.4.3) shall be included in the report of analysis.

5.2.2 The following information should be included and shall be made available upon request without requirement of purchase:

5.2.2.1 Extraction method (e.g., solvent extraction) including details of the method as appropriate, such as:

5.2.2.1.1 Type of solvent or other extraction medium used (e.g., methanol)

5.2.2.1.2 Extraction temperature, time, solvent volume, use of agitation, or method of concentration, as appropriate

5.2.2.1.3 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)

5.2.2.1.4 Other experimental information and observations deemed pertinent by the analyst

5.2.2.1.5 Any internal or external chemical standards being used

5.2.2.2 A table of peak information for analytes detected including those other than the compounds being targeted for each sample. The table includes:

5.2.2.2.1 Major analytes defined as peaks with area greater than 5% of the most abundant peak in the chromatogram. No analyte below minimum quantifiable figures of merit (see 5.1.2.2.4.3) shall be included in the report of analysis.

5.2.2.2.2 Peak retention times of major analytes, defined as peaks with area greater than 5% of the most abundant peak in the chromatogram.

5.2.2.2.3 Compound names or identifier determined by one of the following:

5.2.2.2.3.1 Calibration standards

5.2.2.2.3.2 Library matching software (including confidence score)

5.2.2.2.3.3 Retention time and fragment ion figures for compounds having poor library matches and not contained within the calibration standards

5.2.2.2.4 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

5.2.2.2.5 Calibration curves, descriptions of the calibration curve shall be reported, including

5.2.2.2.5.1 Linear regression equation for the quantified compounds

5.2.2.2.5.2 Correlation coefficient (R^2) values

5.2.2.2.5.3 Minimum quantifiable figures of merit, e.g., or chemical analysis methods, reporting minimum detection limits.

5.2.2.2.5.4 Any error or statistical analysis completed

5.3 The Report of Analysis for the canine odor recognition assessment (Scheme 3, Section 4.6)

5.3.1 The following information shall be included:

5.3.1.1 Date of assessment

5.3.1.2 The manufacturing date of material being tested associated lot numbers, when available

Note. The manufacturer's best practice is to provide lot numbers, date of manufacture, and age of original/raw source material (e.g., real explosive materials for sorption aids or chemicals for mimic aids) for each training aid sold.

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

5.3.1.4 Starting mass of the training aid being tested, as well as any sample manipulation (e.g., subsampling or repackaging)

5.3.1.5 Testing results, including:

5.3.1.5.1 Total number of canines in the alternative and true groups

5.3.1.5.2 Total number and percentage of true positives to true material separately for each type of assessment (baseline and generalization)

5.3.1.5.3 Total number and percentage of true positives to alternative training aids in question separately for each type of assessment (baseline and generalization)

5.3.1.5.4 Total number and percentage of false positives separately for blanks and distractors and for each type of assessment (baseline and generalization)

5.3.2 The following information should be included and shall be made available upon request without requirement of purchase:

5.3.2.1 Information regarding the test set-up, including:

5.3.2.1.1 Number of canines used in the test and their prior experience/training including:

5.3.2.1.1.1 Age in years and prior experience of the canines and handlers with the target being tested and certifications, if any

5.3.2.1.1.2 Descriptions of how the canines was shown to be proficient in detection prior to the assessment (e.g., how a baseline capability assessment qualifying search was conducted prior to assessing the training aid)

5.3.2.1.2 Number and type of blanks, distractors, and targets

5.3.2.1.3 Descriptions of the assessment searches (e.g., odor recognition assessment vs. odor recognition in operational context)

5.3.2.2 Environmental conditions during the assessment

5.3.2.3 All types of containment used

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

Appendix A.
(informative)

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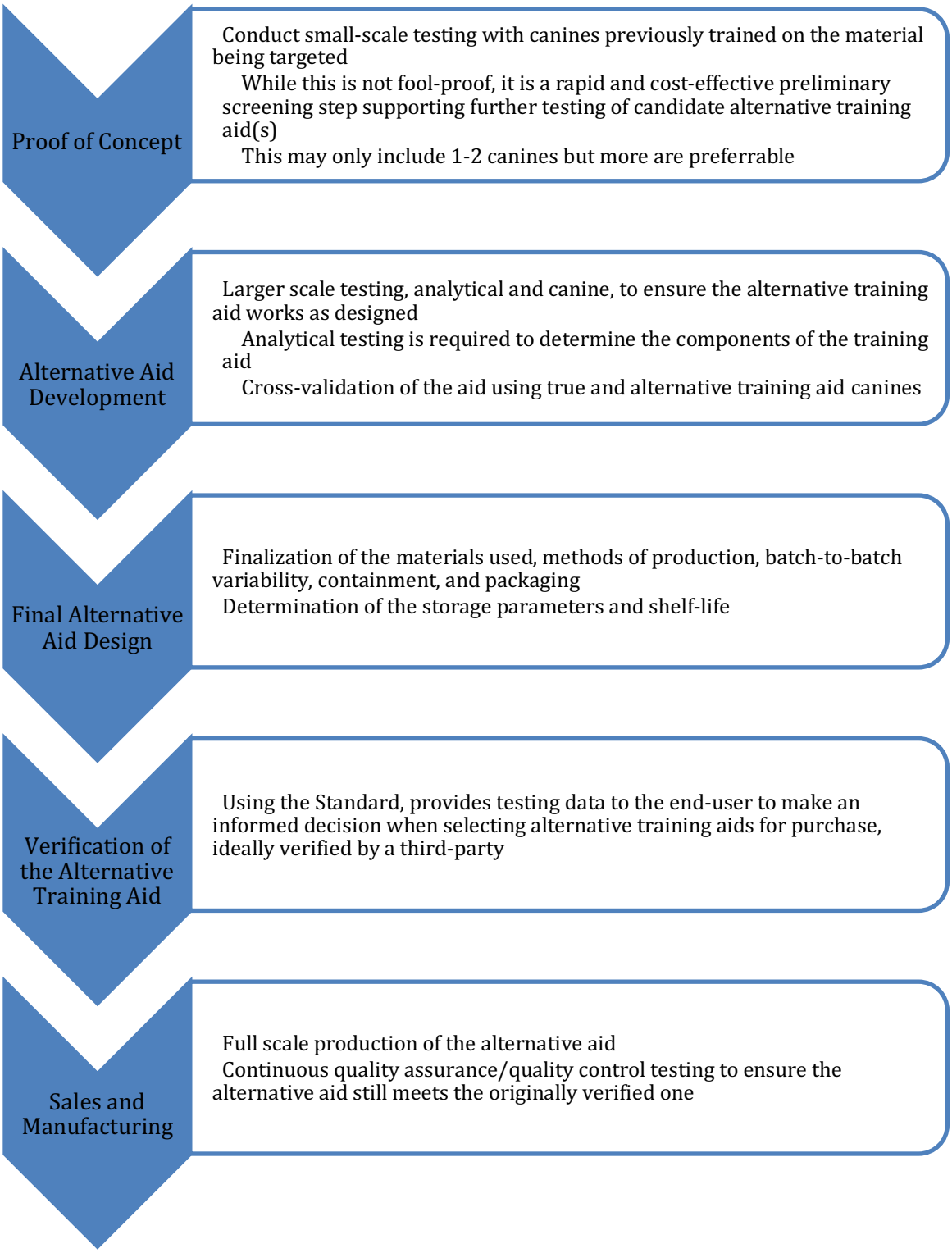
Appendix B. Types and definitions of detection canine training aids[2,4,9]

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(s) 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(s), could be sorption of from true material(s) 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)[1], universal detector calibrant (UDC)[7]

Note. PMTA are not discussed in the main body of this document; however, it is included in this table for educational purposes[1].

Appendix C. 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 that ideally need to occur before training aid verification to ensure that an efficacious training aid is being developed. These steps are outside of the scope of the attached standard. Alternative training aids that have been on the market have likely gone through several of the steps, but will likely need to be verified to ensure quality assurance and quality control of the alternative aid. This 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.


Proof of Concept
Conduct small-scale testing with canines previously trained on the material being targeted
While this is not fool-proof, it is a rapid and cost-effective preliminary screening step supporting further testing of candidate alternative training aid(s)
This may only include 1-2 canines but more are preferrable
Alternative Aid Development
Larger scale testing, analytical and canine, to ensure the alternative training aid works as designed
Analytical testing is required to determine the components of the training aid
Cross-validation of the aid using true and alternative training aid canines
Final Alternative Aid Design
Finalization of the materials used, methods of production, batch-to-batch variability, containment, and packaging
Determination of the storage parameters and shelf-life
Verification of the Alternative Training Aid
Using the Standard, provides testing data to the end-user to make an informed decision when selecting alternative training aids for purchase, ideally verified by a third-party
Sales and Manufacturing
Full scale production of the alternative aid
Continuous quality assurance/quality control testing to ensure the alternative aid still meets the originally verified one

Appendix D. 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 and instrumental testing 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 the Testing Standard Table (TST) below.

Table D.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 D.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.