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OSAC 2024-S-0023

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

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



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OSAC Proposed Standard

DRAFT 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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Disclaimer:

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The STR consists of an independent and diverse panel, which may include subject matter experts, human factors scientists, quality assurance personnel, and legal experts as applicable. The

59 selected group is tasked with evaluating the proposed standard based on a defined list of
60 scientific, administrative, and quality assurance based criteria.

61 For more information about this important process, please visit our website
62 at: [https://www.nist.gov/organization-scientific-area-committees-forensic-science/scientific-](https://www.nist.gov/organization-scientific-area-committees-forensic-science/scientific-technical-review-str-process)
63 [technical-review-str-process](https://www.nist.gov/organization-scientific-area-committees-forensic-science/scientific-technical-review-str-process)
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113 **Standard for the Systematic Verification of Alternative Training Aids for Detection Canine**
114 **Disciplines**

115 **1 Scope**

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

124
125 This Standard serves as a foundational document with requirements for conducting verification
126 tests. It is not intended as a detailed description of chemical analysis and canine assessment
127 methodologies, which will be included in separate standards. The principles of good laboratory
128 practice and record keeping will be applied to the concepts in this document.

129
130 **1.1** This standard addresses verification of alternative training aids for detection canines by
131 both analytical methods and canine testing.

132
133 **1.2** This standard describes a systematic process for assessing alternative training aids,
134 including the instrumental chemical composition analysis (solid/liquid and headspace
135 analysis) and canine training efficacy.

136
137 **1.3** This standard is applicable to and defines categories of alternative training aids for
138 detection canines.

139
140 **1.4** It is not the intent of this document to guide research and development of formulation
141 or composition for training aid manufacturers, but provide the canine community with
142 the means to evaluate the alternative training aid for its use, as intended by the training
143 aid producer.

144
145 **1.5** Verification, both primary and secondary, provide feedback to both the canine
146 community, as well as the producer when verification tests are completed by a third
147 party.

148
149 **1.6** Verification assesses the strengths and limitations of training aid(s) resulting in reliable
150 and scientifically supported recommendations for use.

151
152 **1.7** Due to differences in sensitivity and selectivity between canines and instruments, the
153 analytical limit of detection may not be equivalent³, thus the standard provides a

154 framework for training aid verification by both instrument and canine.

155

156 **1.8** This standard is intended for use by competent practitioners with the requisite formal
157 education, discipline-specific training, and demonstrated proficiency to perform the
158 procedures described herein.

159

160 **1.8.1** For chemical analysis, this standard is intended to be carried out in an
161 analytical laboratory with established ISO17025 accreditation, or its
162 equivalent accreditation, and with the proper space, equipment, and
163 personnel to carry out the procedures described herein.

164

165 **1.8.2** For the canine research, this standard is intended to be carried out by
166 performers that have established and documented canine testing capabilities
167 to carry out the protocols detailed below and conducted using protocols that
168 have been approved by a governing body, such as an Institutional Animal Care
169 and Use Committee (IACUC), as appropriate.

170

171 **1.9** Current canine training aid verification research efforts do not use the same statistical
172 rigor found in many scientific fields, like analytical chemistry measurements. This issue is
173 due in part to the difficulty in recruiting a sufficient number of odor detection dogs and
174 handlers and/or a sufficient number of detection dogs with the proper threat signature
175 training. In addition, some studies require that dogs must be tested on odors they have
176 not previously encountered, which can be both difficult to recruit and costly to kennel
177 and train. As a result, the canine sample size may be too small to draw any firm
178 conclusions. A full discussion on the statistical considerations pertinent to canine training
179 aid validation studies can be found in the follow-up companion document, Standard for
180 the Canine Evaluation of Training Aids for Canine Detection of Explosives. To determine
181 the minimum number of dogs for a canine training aid validation study at a selected level
182 of statistical confidence, the following references may also be consulted^{4,5}.

183

184 **1.10** This standard does not purport to address all of the possible safety concerns, if any,
185 associated with its use. It is the responsibility of the user of this standard to establish
186 appropriate safety, health, and environmental practices and determine the applicability
187 of regulatory requirements prior to use.

188

189 **2 Normative References**

190 There are no normative reference documents.

191 **3 Terms and Definitions**

192

193 For purposes of this document, the following discipline specific definitions apply. Please refer to
194 ASB Technical Report 025, Crime Scene/Death Investigation – Dogs and Sensors – Terms and

195 Definitions, First Edition, 2017 for a comprehensive listing of detailed general detection canine
196 definitions.

197 **3.1**

198 **alternative training aid**

199 Any type of training material that does not use target material as ordinarily encountered by
200 detection canine while deployed; commonly used in the cases where the true material is
201 hazardous, has limited availability, or controlled access; subclassifications include, Sorption,
202 Mimic, Dilution, and Vigilance Aids.

203
204 **3.2**

205 **baseline capability assessment**

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

211
212 **3.3**

213 **blank**

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

216
217 A control where a specified component(s) is not present (Instrumental definition).

218
219 *Discussion.* Blanks with various designations can be specified, such as system blank, process
220 blank, method blank, reagent blank, solvent blank, etc. Certain blanks may also serve as a
221 negative control.

222
223 **3.4**

224 **blank search**

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

226
227 **3.5**

228 **blank training aid**

229 A training aid composed of all the training aid materials except the target compound(s), such as
230 substrate, containment, solvent, etc. The blank training aid has undergone all of the same
231 manufacturing procedures as the training aid.

232
233 **3.6**

234 **canine handler**

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

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

240

241 **3.7**

242 **canine team**

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

244

245 **3.8**

246 **chromatographic feature**

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

249

250 **3.9**

251 **control detection canine**

252 Canine(s) trained in the detection of the target odor using the true material(s) and certified or
253 otherwise shown to be proficient in its detection. For verifying alternative training aids, these
254 canines are trained on the true material(s) prior to being used for training aid assessment.

255

256 **3.10**

257 **canine trainer**

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

261

262 **3.11**

263 **data recorder**

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

266

267 **3.12**

268 **dilution aid**

269 Trace amount of liquid- or solid-phase target material added to or encapsulated into a substrate
270 in order to render the target material non-hazardous.

271

272 **3.13**

273 **distractor**

274 Non-target stimuli placed or naturally occurring within a search area. These can include: human
275 scent, toy, food or animal odor, or non-target odorous chemical etc.

276

277

278

279

280 **3.14**

281 **double-blind**

282 Scientific usage: This condition occurs when neither the experimenter/canine handler, nor any
283 persons visually accessible to the canine or handler or recording data, know which
284 treatments/manipulations are given to which subjects. Operational usage: In the evaluation of a
285 canine team's ability to detect the target odor, neither the the data recorder, observer, assessor,
286 certifying official, and evaluator, nor the canine handler knows the location of the target odor or
287 whether target odor is present (i.e., a blank/null search).

288

289 **3.15**

290 **dynamic headspace concentration**

291 An extraction technique in which a portion of the headspace vapors is exchanged from the
292 sampling container and concentrated onto an adsorbent medium through applied positive or
293 negative pressure.

294

295 **3.16**

296 **experimental detection canine**

297 Canine(s) that has not previously been trained to or have known incidental exposure to the target
298 odor related to the training aid being verified. For verifying alternative training aids, these canines
299 are trained on the alternative training aid.

300

301 **3.17**

302 **false positive**

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

305

306 **3.18**

307 **gas chromatography-electron capture detection (GC/ECD)**

308 A method of analysis in which substances are separated by differential migration in a gas mobile
309 phase flowing through or past a stationary phase (GC) coupled with a detection technique
310 (electron capture detection).

311

312 **3.19**

313 **gas chromatography-mass spectrometry (GC/MS)**

314 A method of analysis in which substances are separated by differential migration in a gas mobile
315 phase flowing through or past a stationary phase (GC) coupled with a detection technique (mass
316 spectrometry).

317

318 **3.20**

319 **generalization**

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

323

324 **3.21**

325 **generalization assessment**

326 An odor recognition assessment that tests a canine's response to untrained target materials
327 following specific training on related target materials. In the case of training aid verification, for
328 the control detection canine group, the generalization assessment tests the proficiency of the
329 canine team to locate the alternative training aid, and for the experimental detection canine
330 group, the generalization assessment tests the proficiency of the canine team to locate the true
331 material.

332

333 **3.22**

334 **headspace**

335 The vapor emanating from a specific source of interest.

336

337 **3.23**

338 **headspace analysis**

339 Practice for sampling and analyzing the headspace.

340

341 **3.24**

342 **liquid chromatography – mass spectrometry (LC/MS)**

343 A method of analysis in which substances are separated by their differential migration in a liquid
344 mobile phase flowing through or past a stationary phase (LC) coupled with a detection technique
345 (mass spectrometry).

346

347 **3.25**

348 **liquid chromatography – ultraviolet spectroscopy (LC/UV)**

349 A method of analysis in which substances are separated by their differential migration in a liquid
350 mobile phase flowing through or past a stationary phase (LC) coupled with a detection technique
351 (ultraviolet spectroscopy).

352

353 **3.26**

354 **linear regression**

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

357

- 358 **3.27**
359 **mimic aid**
360 Chemical(s) selected with the goal of imitating the real odor of a target material.
361
- 362 **3.29**
363 **service life**
364 The period of time for which the training aid is in routine operational use and maintains its
365 efficacy.
366
- 367 **3.30**
368 **shelf life**
369 The period of time during which a training aid may be stored and maintains its efficacy.
370
- 371 **3.31**
372 **single blind**
373 Scientific usage: This condition occurs when the canine handler does not know which
374 treatments/manipulations are given to which subjects. Operational usage: In the evaluation of a
375 canine team's ability to detect the target odor; the data recorder, observer, assessor, certifying
376 official, or evaluator know the location of the target odor or whether target odor is present (i.e.,
377 a blank/null search), and the canine handler does not.
378
- 379 **3.32**
380 **static headspace concentration**
381 An extraction technique in which a portion of the headspace vapor is removed from the sample
382 container.
383
- 384 **3.33**
385 **solid-phase microextraction (SPME)**
386 An extraction technique where the analytes from a sample are adsorbed onto a fiber coated with
387 an adsorptive medium and thermally desorbed into the injection port of a gas chromatograph.
388
- 389 **3.34**
390 **solvent extraction**
391 The transfer of chemical compounds from a material to a solvent.
392
- 393 **3.35**
394 **sorbent tubes**
395 A sample-collection tube in which the sample is pumped onto tubes packed with one or more
396 sorbents.
397
398

399 **3.36**
400 **sorption aid**
401 Sorption of gas-phase compounds from the targeted material(s), could be sorption of from true
402 material(s) or from another “alternative” training aid.

403 *Note. Sorption aids are commonly referred to as “odor soaks”. Soaking of a liquid or solid target*
404 *material onto a substrate is considered a dilution aid.*

405

406 **3.37**
407 **target**

408 The odor for which the canine is trained to respond.

409

410 **3.38**

411 **test administrator**

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

414

415 **3.39**

416 **thermal desorption**

417 A method of introducing a sample that was collected on a sorbent substrate into an instrument
418 for analysis using heat and a flow of inert gas to transfer the compounds for analysis.

419

420 **3.40**

421 **thermal desorption tube**

422 A sample-collection tube in which the sample is pumped through applied positive or negative
423 pressure into tubes packed with one or more sorbents.

424

425 **3.41**

426 **third-party testing**

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

429

430 **3.42**

431 **training aid characterization**

432 The process of identifying all of the chemical components of a training aid.

433

434 **3.43**

435 **training aid primary verification**

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

438

439

440

441 **3.44**
 442 **training aid readiness level (TARL)**
 443 Degree of foundational research and development relating to both canine and instrumental
 444 testing for the verification and deployment of a canine detection training aid. See Appendix C
 445 for detailed description.

446
 447 **3.44**
 448 **training aid secondary verification**
 449 A process of evaluation to verify producer’s claims and ensure that the training aid continues to
 450 meet parameters defined in the training aid primary verification.

451
 452 **4 Requirements**

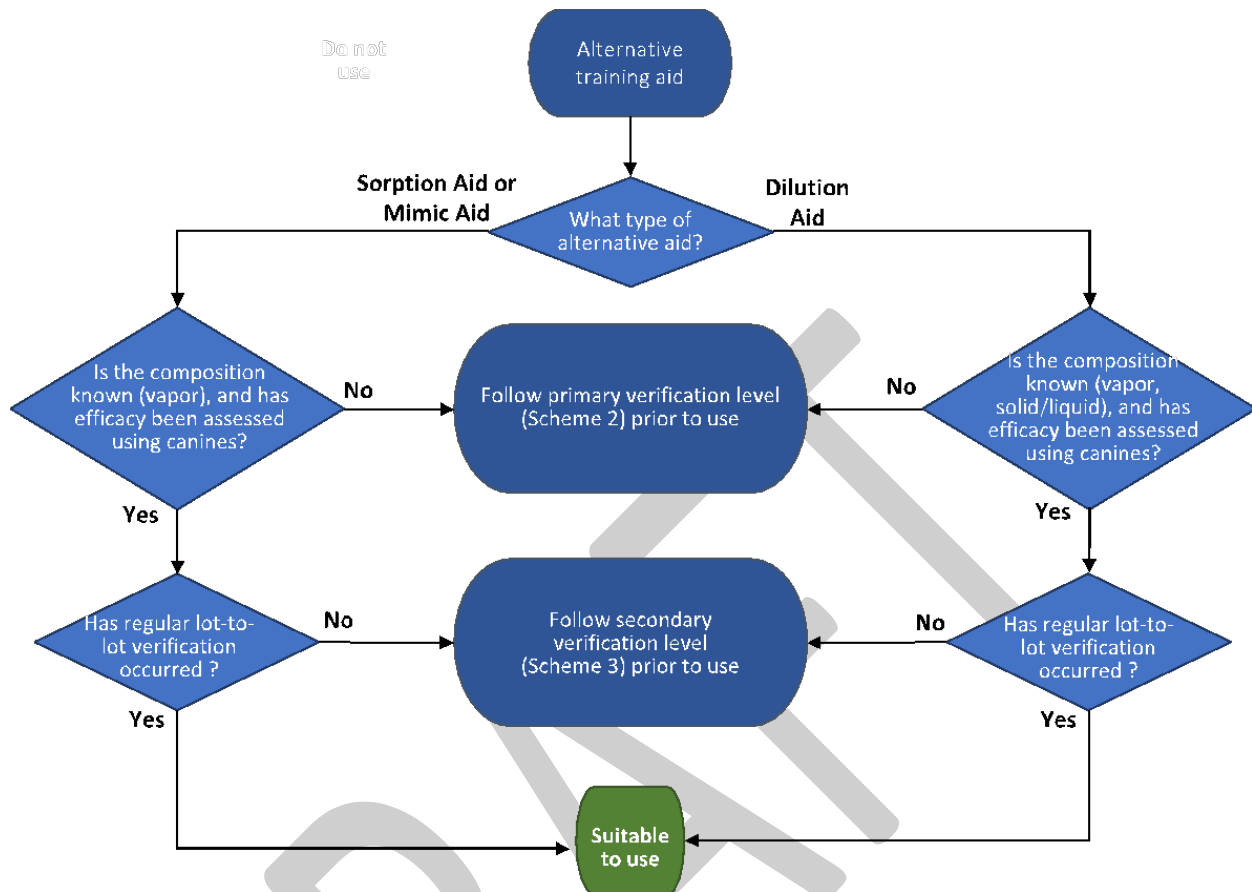
453 **4.1 Overview**

454 **4.1.1** Table 1 and Scheme 1 describe the primary verification level for newly developed or
 455 previously untested aids and the secondary verification level for regular production
 456 testing after primary verification has occurred.

457 **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	And/or
Canine testing	Solid/liquid analysis

458



459

460

Scheme 1. Assessment of a training aid.

461

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

462

463

4.1.3 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.

464

465

466

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

467

468

469

4.1.4 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 IACUC, as appropriate.

470

471

472

473

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

474

475 **4.2 Primary verification level:**

476 **4.2.1** Primary verification shall be conducted to verify that a newly developed or previously
477 untested alternative training aid meets the claims of the producer and/or end-user
478 requirements.

479 **4.2.2** The results of primary verification shall define the parameters to be met by future
480 secondary verifications. Acceptable deviations from primary verification results shall be
481 defined prior to secondary verification.

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

484
485 **4.2.3** Primary verification shall include both instrumental chemical composition analysis
486 (qualitative, semi-quantitative, or quantitative) and canine testing.

487 **4.2.4** Instrumental chemical composition analysis includes:

488 **4.2.4.1** For sorption and mimic aids, the chemicals present in the headspace shall be
489 characterized (Scheme 2a), and the chemicals present in the solid and liquid phases
490 should be characterized (Scheme 2b)

491 **4.2.4.2** For dilution aids, the chemical(s) present in the headspace (Scheme 2a) and chemical(s)
492 present in the solid or liquid phases (Scheme 2b) shall be characterized.

493 **4.2.5** Odor recognition assessments of the alternative training aid shall include detection
494 canines that have not been previously trained for the corresponding detection discipline
495 (experimental group) and should additionally include detection canines (control group)
496 that have been trained for the corresponding detection discipline (Scheme 3).

497 **4.2.6** Primary verification testing results shall be documented and access to the report shall
498 be available without requirement of purchase. (See Section 5)

499 **4.3 Secondary verification:**

500 **4.3.1** Secondary verification should be conducted to verify producer's claims and ensure that
501 the training aid continues to meet parameters defined in the primary verification.

502 **4.3.2** Third-party laboratory testing should be employed for secondary verification.

503 **4.3.3** Secondary verification shall be conducted only after primary verification is complete.

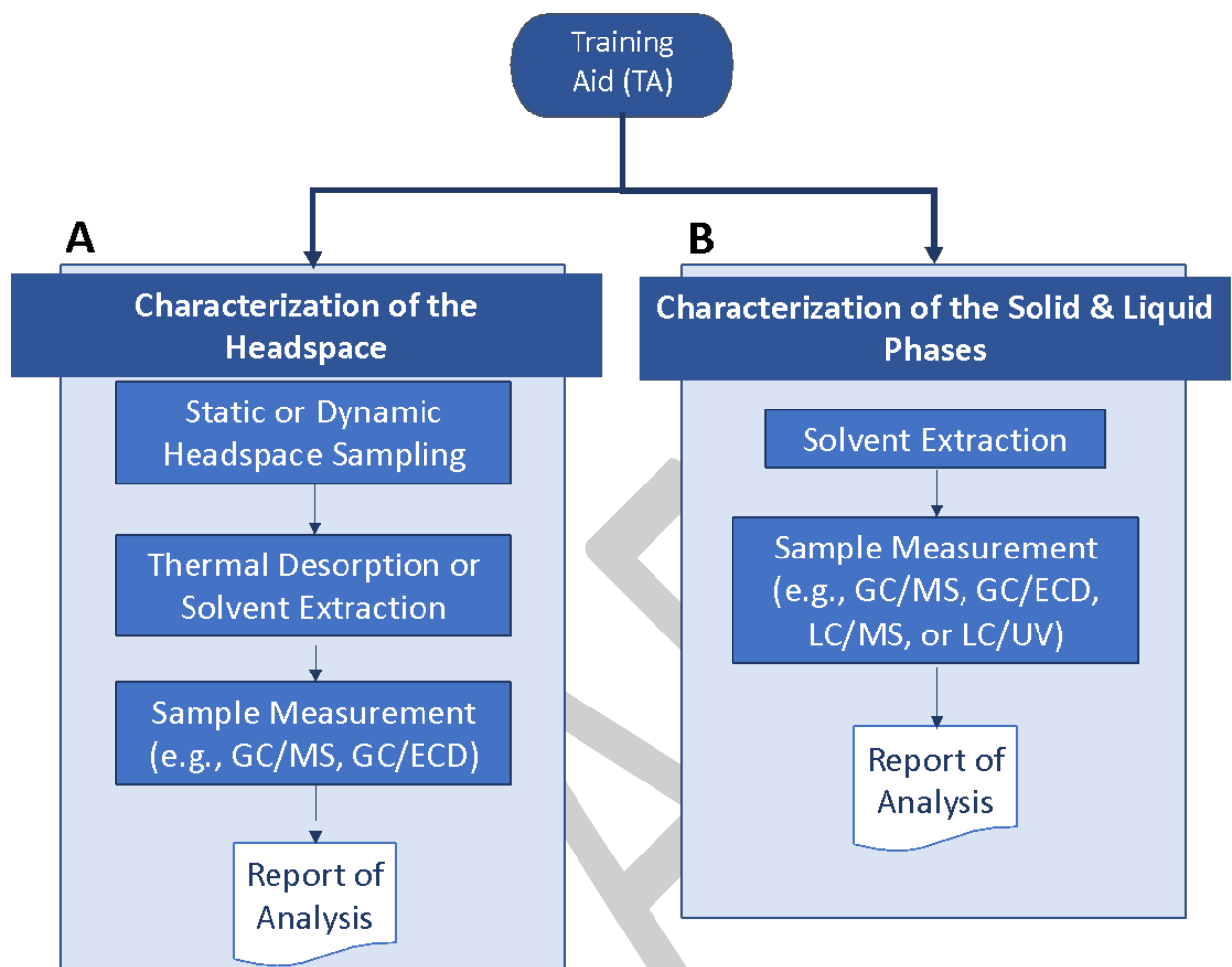
504 **4.3.4** Laboratory chemical characterization includes:

505 **4.3.4.1** For sorption and mimic aids, the headspace shall be characterized (Scheme 2a), and the
506 chemicals present in the solid and liquid phases should be characterized (Scheme 2b)

- 507 **4.3.4.2** For dilution aids, the chemical(s) present in the headspace (Scheme 2a) and chemical(s)
508 present in the solid or liquid phases (Scheme 2b) shall be characterized.
- 509 **4.3.5** Verification shall be performed as often as necessary to ensure consistency across lots
510 and shall be part of the manufacturing's quality control and standard operating
511 procedure (SOP).
- 512 **4.3.5.1** The verification SOP shall be established prior to verification and shall specify, but not
513 limited to, the type of samples to be tested, the frequency of monitoring, acceptable
514 analyte amounts and reproducibility, and background characterization.
- 515 **4.3.5.2** Actions to take in the event of deviations from the prescribed parameters should be
516 documented prior to method implementation and made available for the end user upon
517 request without requirement of purchase.
- 518 Note. See ISO9000 as an example of guidance.¹
- 519 **4.3.6** Secondary verification testing results shall be documented and access to the full report
520 shall be available without requirement of purchase. (See Section 5).
- 521 **4.4 Characterization of the chemicals present in the headspace (Scheme 2a)**

¹ <https://www.iso.org/standards/popular/iso-9000-family>

522



523

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

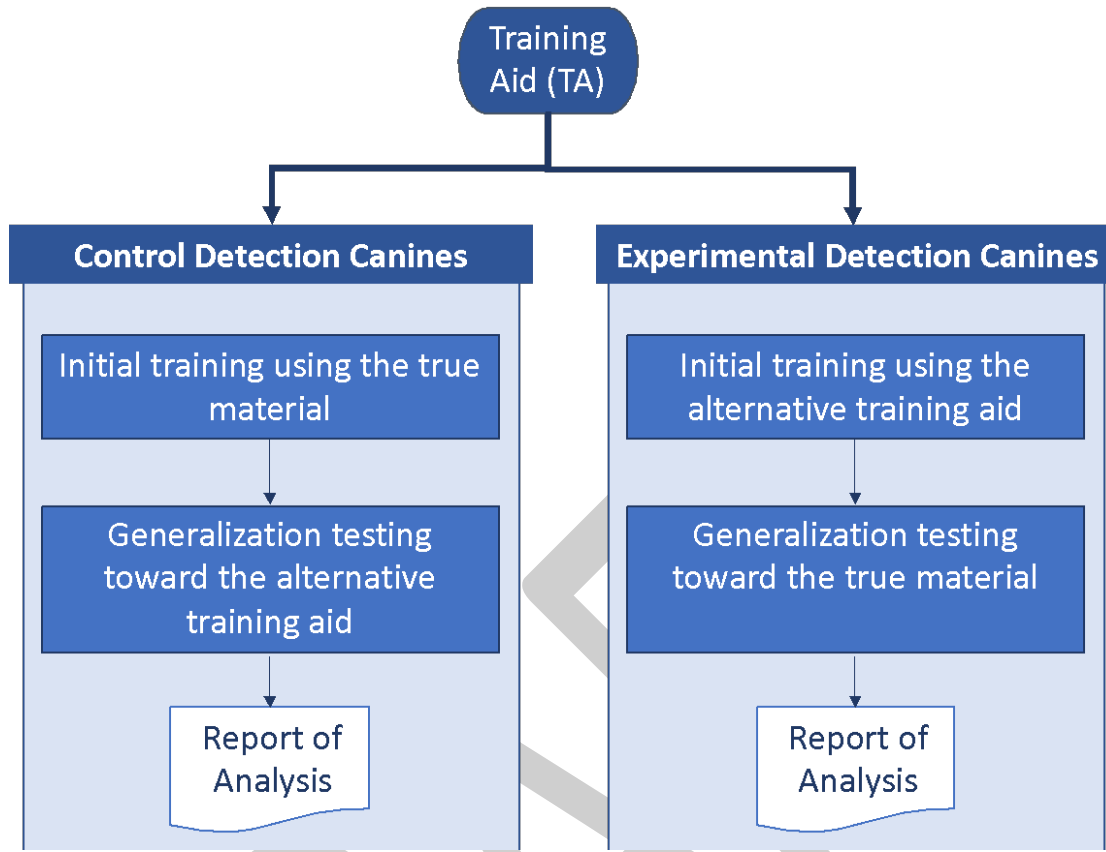
525 **4.4.1** Many techniques, such as direct headspace analysis using mass spectrometry or proton
 526 transfer reaction mass spectrometry, may be used to complement, but not replace the
 527 method described below.

528 **4.4.2** For sampling the headspace, the sample will require collection of the vaporous
 529 compounds. At a minimum, headspace compounds shall be collected by static
 530 headspace sampling or dynamic headspace sampling.

531 **4.4.3** Sampling techniques should include solid phase microextraction (SPME) fibers or
 532 thermal desorption tubes.

533 **4.4.4** The extracted headspace sample shall be measured using GC/MS or GC/ECD.

- 534 **4.4.4.1** Thermal desorption is recommended for introducing the extracted headspace sample
535 into the measurement instrument. If thermal degradation from the desorption process
536 is a concern, then the sample should be eluted from the SPME fibers or sorbent tubes
537 using solvent extraction.
- 538 **4.4.4.2** Blank SPME fibers and sorbent tubes shall be extracted similarly for assessing interfering
539 background compounds (e.g., siloxane peaks from column or fiber coating).
- 540 **4.4.5** Blank training aids shall be prepared and analyzed in the same manner for assessing
541 interfering background compounds (e.g., unwanted compounds from the blank training
542 aid substrate).
- 543 **4.4.6** At least three separate replicate samples, including training aid material and blanks, shall
544 be measured and reported. If available, replicate samples should be obtained from
545 different samples in the same lot. If that is not feasible due to limited number of aids
546 available, triplicate measurements may be taken of a single aid, and reported as such.
- 547 **4.5 Chemical composition measurements of the targets in the solid or liquid phase**
548 **(Scheme 2b)**
- 549 **4.5.1** Many techniques, such as Fourier transform infrared spectroscopy (FTIR) or direct
550 analysis in real time (DART) mass spectrometry, may be used to complement, but not
551 replace the method described below.
- 552 **4.5.2** For sampling solid phase materials, the sample shall be subjected to solvent extraction
553 and analysis.
- 554 **4.5.3** For sampling liquid phase materials, the sample shall be subjected to solvent extraction,
555 dilution of the original liquid material, or analysis of the neat material by direct
556 immersion SPME or direct injection.
- 557 **4.5.4** The sample generated in either 4.5.2 or 4.5.3 should be analyzed using direct injection
558 or immersion SPME with GC or LC separation and ECD or MS detection.
- 559 **4.5.5** Blank training aids, if available, shall be prepared and analyzed in the same manner for
560 assessing interfering background compounds (e.g., unwanted compounds from the
561 blank training aid substrate).
- 562 **4.5.6** At least three separate replicate samples, including training aid material and blanks, shall
563 be measured and reported. If available, replicate samples should be obtained from
564 different samples in the same lot. If that is not feasible due to limited number of aids
565 available, triplicate measurements may be taken of a single aid, and reported as such.
- 566 **4.6 Canine odor recognition assessment (Scheme 3)**



567

568 **Scheme 3. Canine testing design for primary verification of an alternative training aid using**
 569 **control and experimental detection canine groups.**

570 **4.6.1** Canine testing for primary verification shall include both control and experimental
 571 detection canines⁷.

572 **4.6.1.1** The control detection canines shall have been trained in the detection of the target odor
 573 using the true material(s) and have been certified or otherwise shown to be proficient in
 574 its detection prior to the assessment.

575 **4.6.1.2** The experimental detection canines shall have not previously been trained to or have
 576 known incidental exposure to the target odor related to the training aid being verified.

577 **4.6.1.3** Both detection canine groups shall be selected according to the criteria in ANSI/ASB STD
 578 085.

579 Note. The canine acceptance criteria may be modified or lessened as the testing protocols
 580 require.

581 **4.6.1.4** Both detection canine groups shall be trained by a canine trainer.

582 **4.6.1.5** The control and experimental groups may be tested during the same odor recognition
583 assessment or on separate occasions, though the testing shall be set up in identical
584 manners.

585 **4.6.1.6** The control and the experimental groups shall complete a baseline capability assessment
586 prior to completing the generalization assessment toward the alternative training aids
587 or the true materials.

588 **4.6.2** In addition to the control and experimental detection canines, the personnel that should
589 be involved in the assessment are included in Table 2.

590 Note, for more detail, see the standard for designing non-, single-, and double-blind,
591 detection canine assessments.

592 **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

593
594 **4.6.3** The assessment(s) shall demonstrate canine generalization proficiency and
595 reproducibility of results between multiple canines towards replicate alternative training
596 aids.

597 **4.6.4** The desired outcome of the search is the correct identification of the number and
598 placement of the training aids by the canine team.

599 **4.6.4.1** For the control group, baseline capability assessment is the proficiency of the canine
600 team to locate the true material, and the generalization assessment is the proficiency of
601 the canine team to locate the alternative training aids.

602 **4.6.4.2** For the experimental group, baseline capability assessment is the proficiency of the
603 canine team to locate the alternative training aid, and the generalization assessment is
604 the proficiency of the canine team to locate the true material.

605 **4.6.5** The assessment shall consist of the following components and parameters described in
606 the discipline-related standards such as ANSI/ASB STD 092 and 076.

607 **4.6.5.1** Canine testing for the primary verification of the alternative training aids shall include
608 one or a series of odor recognition assessments.

609 **4.6.5.1.1** An odor recognition assessment is made up of individual searches. Each search
610 shall include target odors, distractors, and blanks.

611 **4.6.5.1.1.1** Distractors shall include items used in testing (gloves, wipes,
612 substrates, markers, etc.) as well as other non-target odors (lotions, soaps, foods,
613 crayons, plastics, etc.). Distractors shall be handled and contained in an identical
614 manner to the target odors.

615 **4.6.5.1.1.2** Blanks shall include any containment or substrate used in or with
616 the target odors.

617 **4.6.5.1.1.3** The order of targets, distractors and blanks in a search shall be
618 randomized for each canine being tested, whenever possible.

619 **4.6.5.1.2** All target materials shall be handled and stored in such a way to minimize cross-
620 contamination and manufactured guidelines regarding storage shall be followed
621 when provided. If the manufacturer does not provide storage guidelines, aids shall
622 be stored at room temperature or below.

623 Note. Ideally, two layers of odor containment are used, an inner, primary odor containment layer
624 that prevents odor from the container from contaminating the aid, and an outer, secondary odor
625 containment layer that prevents odor from the environment from reaching the aid. For example,
626 a mylar or “odor-proof” bag can be used as a primary odor containment layer, while a canning
627 jar, or the like, can be used as the secondary odor containment layer ^{7,2}.

628 **4.6.5.2** The sample containers shall be placed in a location that minimizes environmental
629 influences that may affect the odor.

630 **4.6.5.3** The assessment shall be at minimum single-blind, but should be conducted double-blind
631 whenever possible, and should be reported as such.

632 Note. It is best practice for each search in the assessment to remain double-blind until
633 the handler calls the outcome (ex. calls an “alert”), and then the test administrator can
634 indicate whether the outcome is correct.

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

641

642 **5 Reporting**

643 The output from the verification of alternative training aids is a Report of Analysis. The Report
644 of Analysis provides the assessment of alternative training aids, via defined results from
645 instrumental chemical composition analysis (solid/liquid and headspace analysis) and canine
646 training aid efficacy. This report should be requested from potential acquisition personnel for
647 the end user, to ensure verification of claims from the manufacturer and to ensure proper fit to
648 end use.

649 For Schemes 2a and 2b (above in section 4.4), the Report of Analysis informs the end-user about
650 the chemical composition of the vapor and solid or liquid phases. Qualitatively, an ideal training
651 aid has the same target compounds as the true material. Quantitatively, the target compounds
652 in an ideal training aid are in abundance compared to the background compounds. The target
653 compounds and composition should be predefined in the test parameters and reported.

654 For Scheme 3, the Report of Analysis gives the odor recognition assessment parameters and
655 outcomes for both the baseline and generalization assessments. The control canine group should
656 generalize to the alternative training aid, and the experimental canine group should generalize
657 to the true material with minimal false responses, as defined in the test parameters.

658 **5.1 The Report of Analysis for characterization of chemicals present in the headspace** 659 **(Scheme 2a; Section 4.4).**

660 **5.1.1** The following information shall be included:

661 **5.1.1.1** Date of analysis and the number of replicates that were measured

662 **5.1.1.2** Form factor (e.g., qualitative descriptions of the substrate material, color, hardness, etc.,
663 and packaging form).

664 **5.1.1.3** Starting mass of the training aid being tested and any sample manipulation (e.g.,
665 subsampling or repackaging).

666 **5.1.1.4** The manufacturing date of material being tested and the associated lot numbers, when
667 available.

668 Note. The manufacturer's best practice is to provide lot numbers, date of manufacture, and age

- 669 of original/raw source material (e.g., real explosive materials for sorption aids or chemicals for
670 mimic aids) for each training aid sold.
671
- 672 **5.1.1.5** Alternative training aid target compounds, if known (e.g., Dinitrotoluene for TNT), and
673 references or rationale for the how targeted compounds were chosen.
- 674 **5.1.1.6** Results of analysis including major analytes, defined as peaks with area greater than 5%
675 of the most abundant peak in the chromatogram. No analyte below minimum
676 quantifiable figures of merit shall be included in the report of analysis.
- 677 **5.1.2** The following information should be included and shall be made available upon request
678 without requirement of purchase:
- 679 **5.1.2.1** Headspace extraction method (e.g., SPME, thermal desorption tube, etc.) including
680 details of the method as appropriate, such as:
- 681 **5.1.2.1.1** Type of substrate or substrate coating (polydimethylsiloxane for SPME, Tenax for
682 thermal desorption, etc.)
- 683 **5.1.2.1.2** Extraction temperature, time, and/or volume
- 684 **5.1.2.1.3** Size of the sample container (e.g., 1 gallon paint can) and whether the container
685 is sealed or opened
- 686 **5.1.2.1.4** Analytical instrumentation parameters (e.g., GC/MS methods such as
687 temperature ramping, separation time, mass spectral scan range, and make and
688 model of the instrument)
- 689 **5.1.2.1.5** Other experimental information and observations deemed pertinent by the
690 analyst
- 691 **5.1.2.1.6** Any internal or external chemical standards being used
- 692 **5.1.2.2** A table of peak information for analytes detected including those other than the
693 compounds being targeted for each sample. The table includes:
- 694 **5.1.2.2.1** Peak retention times of major analytes, defined as peaks with area greater than
695 5% of the most abundant peak in the chromatogram
- 696 **5.1.2.2.2** Compound names or identifier determined by;
- 697 **5.1.2.2.2.1** Calibration standards
- 698 **5.1.2.2.2.2** Library matching software (including confidence score)

- 699 **5.1.2.2.2.3** Retention time and fragment ion figures for compounds having
700 poor library matches and not contained within the calibration standards
- 701 **5.1.2.2.3** The integrated peak areas or ratio of peak area to internal standard
- 702 **5.1.2.2.4** If semi-quantitative measurements are attempted using calibration curves,
703 descriptions of the calibration curve shall be reported, including
- 704 **5.1.2.2.4.1** Linear regression equation for the quantified compounds
- 705 **5.1.2.2.4.2** Correlation coefficient (R^2) values
- 706 **5.1.2.2.4.3** Minimum quantifiable figures of merit, e.g., or chemical analysis
707 methods, reporting minimum detection limits
- 708 **5.1.2.3** Chromatograms pertaining to each sample in an appendix
- 709 **5.1.3** If a shelf-life and/or operational lifetime is determined, the test conditions used during
710 these analyses, including containment and storage conditions, shall be included.
- 711 **5.2** **The Report of Analysis for chemical composition of the targets in the solid or liquid**
712 **phase (Scheme 2b; Section 4.5)**
- 713 **5.2.1** The following information shall be included:
- 714 **5.2.1.1** Date of analysis and the number of replicates that were measured
- 715 **5.2.1.2** Form factor (e.g., qualitative descriptions of the substrate material, color, hardness, etc.,
716 and packaging form).
- 717 **5.2.1.3** Starting mass of the training aid being tested and any sample manipulation (e.g.,
718 subsampling or repackaging).
- 719 **5.2.1.4** The manufacturing date of material being tested and the associated lot numbers, when
720 available.
- 721 Note. The manufacturer's best practice is to provide lot numbers, date of manufacture, and age
722 of original/raw source material (e.g., real explosive materials for sorption aids or chemicals for
723 mimic aids) for each training aid sold.
- 724
- 725 **5.2.1.5** Alternative training aid target compounds, if known (e.g., TNT or Dinitrotoluene for TNT),
726 and references or rationale for the how targeted compounds were chosen
- 727 **5.2.1.6** Results of analysis including major analytes, defined as peaks with area greater than 5%
728 of the most abundant peak in the chromatogram. No analyte below minimum
729 quantifiable figures of merit shall be included in the report of analysis.

- 730 **5.2.2** The following information should be included and shall be made available upon request
731 without requirement of purchase:
- 732 **5.2.2.1** Extraction method (e.g., solvent extraction) including details of the method as
733 appropriate, such as:
- 734 **5.2.2.1.1** Type of solvent or other extraction medium used (e.g., methanol)
- 735 **5.2.2.1.2** Extraction temperature, time, solvent volume, use of agitation, or method of
736 concentration, as appropriate
- 737 **5.2.2.1.3** Analytical instrumentation parameters (e.g., GC/MS methods such as
738 temperature ramping, separation time, mass spectral scan range, and make and
739 model of the instrument)
- 740 **5.2.2.1.4** Other experimental information and observations deemed pertinent by the
741 analyst
- 742 **5.2.2.1.5** Any internal or external chemical standards being used
- 743 **5.2.2.2** A table of peak information for analytes detected including those other
744 than the compounds being targeted for each sample. The table includes:
- 745 **5.2.2.2.1** Major analytes defined as peaks with area greater than 5% of the most abundant
746 peak in the chromatogram. No analyte below minimum quantifiable figures of
747 merit shall be included in the report of analysis
- 748 **5.2.2.2.2** Peak retention times of major analytes, defined as peaks with area greater than
749 5% of the most abundant peak in the chromatogram.
- 750 **5.2.2.2.3** Compound names or identifier determined by
- 751 **5.2.2.2.3.1** Calibration standards
- 752 **5.2.2.2.3.2** Library matching software (including confidence score)
- 753 **5.2.2.2.3.3** Retention time and fragment ion figures for compounds having
754 poor library matches and not contained within the calibration standards
- 755 **5.2.2.2.4** The integrated peak areas for all compounds in the table as well as the
756 concentration of the targeted analytes as determined by comparison to a
757 calibration curve
- 758 **5.2.2.2.5** Calibration curves, descriptions of the calibration curve shall be reported,
759 including

- 760 **5.2.2.2.5.1** Linear regression equation for the quantified compounds
- 761 **5.2.2.2.5.2** Correlation coefficient (R^2) values
- 762 **5.2.2.2.5.3** Minimum quantifiable figures of merit, e.g., or chemical analysis
763 methods, reporting minimum detection limits.
- 764 **5.2.2.2.5.4** Any error or statistical analysis completed
- 765 **5.3 The Report of Analysis for the canine odor recognition assessment (Scheme 3, Section**
766 **4.6)**
- 767 **5.3.1** The following information shall be included:
- 768 **5.3.1.1** Date of assessment
- 769 **5.3.1.2** The manufacturing date of material being tested associated lot numbers, when
770 available
- 771 Note. The manufacturer's best practice is to provide lot numbers, date of manufacture, and age
772 of original/raw source material (e.g., real explosive materials for sorption aids or chemicals for
773 mimic aids) for each training aid sold.
774
- 775 **5.3.1.3** Form factor (e.g., qualitative descriptions of the substrate material, color, hardness, etc.,
776 and packaging form)
- 777 **5.3.1.4** Starting mass of the training aid being tested, as well as any sample manipulation (e.g.,
778 subsampling or repackaging)
- 779 **5.3.1.5** Testing results, including:
- 780 **5.3.1.5.1** Total number of dogs
- 781 **5.3.1.5.2** Total number and percentage of true positives to true material
- 782 **5.3.1.5.3** Total number and percentage of true positives to training aids in question
- 783 **5.3.1.5.4** Total number and percentage of false positives
- 784 **5.3.2** The following information should be included and shall be made available upon request
785 without requirement of purchase:
- 786 **5.3.2.1** Information regarding the test set-up, including:
- 787 **5.3.2.1.1** Number of dogs used in the test and their prior experience/training including:

788 **5.3.2.1.1.1** Age in years and prior experience of the canines and handlers
789 with the target being tested and certifications, if any

790 **5.3.2.1.1.2** Descriptions of how the canines was shown to be proficient in
791 detection prior to the assessment (e.g., how a baseline capability assessment
792 qualifying search was conducted prior to assessing the training aid)

793 **5.3.2.1.2** Number and type of blanks, distractors, and targets

794 **5.3.2.1.3** Descriptions of the assessment searches (e.g., odor recognition assessment vs.
795 odor recognition in operational context)

796 **5.3.2.2** Environmental conditions during the assessment

797 **5.3.2.3** All types of containment used

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814 **Annex A**
815 (informative)

816
817 **Bibliography**
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820 performance of detection dogs. Crown copyright; 2019. Detection dog guidance notes series
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- 838

839 **Appendix A. Types and definitions of detection canine training aids**

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, Dilution, and Vigilance Aids.
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	Trace amount of 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.
Vigilance Aid	An additional target odor that is not related to their training samples, and is not otherwise likely to be found in their search environment.	Detection performance can be evaluated or maintained by allowing for canines to find and indicate on a vigilance aid, such as when access or use of real material is limited. ex. performance maintaining training aid (PMTA) ¹ , universal detector calibrant (UDC) ⁶

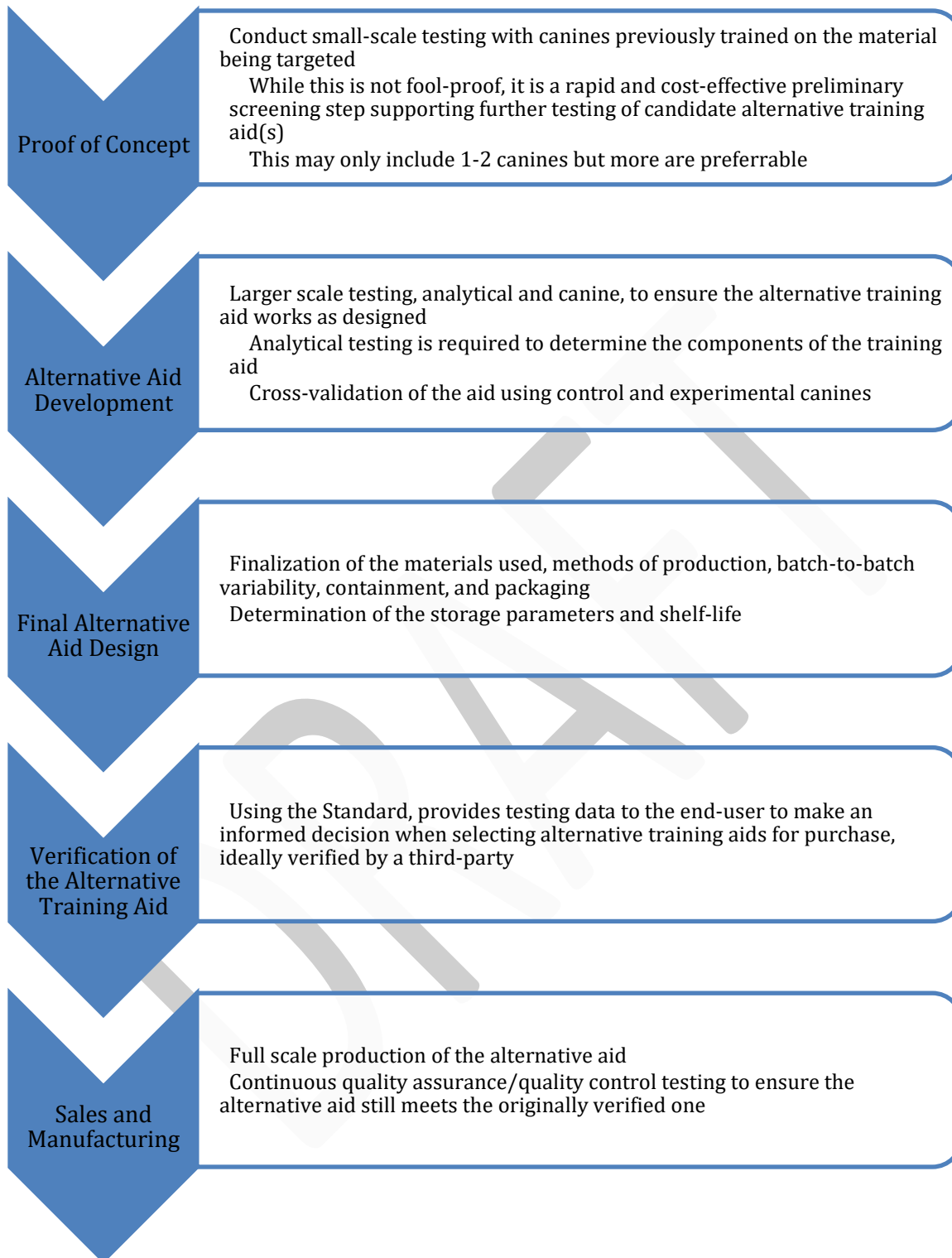
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842 **Appendix B. Example Test Plan for the Development and Verification of a New/Novel**
843 **Alternative Training Aid**

844 The workflow outlined below is to assist persons developing new training aids. There are several
845 steps that ideally need to occur before training aid verification to ensure that a efficacious training
846 aid is being developed. These steps are outside of the scope of the attached standard. Alternative
847 training aids that have been on the market have likely gone through several of the steps, but will
848 likely need to be verified to ensure quality assurance and quality control of the alternative aid.
849 This is solely meant as an example minimum workflow; training aid developers may add
850 additional steps, deviations, or iterations to ensure they are bringing a suitable alternative
851 training aid to the market.

DRAFT



854 **Appendix C. Training aid readiness level (TARL) based on current knowledge of canine**
 855 **detection odorants**

856 The Training aid readiness level (TARL) is defined as the degree of foundational research and
 857 development relating to both canine and instrumental testing for the verification and
 858 deployment of a canine detection training aid. The TARLs are based on verification levels in Table
 859 1 from the main document and the Testing Standard Table (TST) below.

Table C.1. Testing Standard Table

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

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Table C.2. Training Aid Readiness Levels

<i>TARL Level</i>	<i>Requirements</i>
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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