

OSAC 2023-S-0017

Standard for the Articulation of Footwear and Tire Interpretations

Footwear & Tire Subcommittee

Pattern/Physics Interpretation Scientific Area Committee (SAC)

Organization of Scientific Area Committees (OSAC) for Forensic Science



OSAC Proposed Standard

OSAC 2023-S-0017

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Prepared by
Footwear & Tire Subcommittee
Version: 2.0
November 2024

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For more information about this important process, please visit our website at: <https://www.nist.gov/organization-scientific-area-committees-forensic-science/scientific-technical-review-str-process>

Foreword

This document outlines a standard framework for articulating source opinions for the forensic footwear and tire discipline. This standard describes necessary comparative observations and interpretations and provides a model for articulating qualitative source opinions using an evaluative reporting approach. This standard does not, and cannot, address every contingency that may occur when expressing comparison results.

This document has been developed by the Footwear and Tire Subcommittee of the Organization of Scientific Area Committees for Forensic Science through a consensus process and is being proposed for further development through a Standard Development Organization (SDO). This document was developed with input from experts with a broad array of subject matter expertise, including forensic practitioners, researchers, measurement scientists, statisticians, and legal experts.

All hyperlinks and web addresses shown in this document are current as of the publication date of this standard.

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Standard for the Articulation of Footwear and Tire Interpretations

1 Scope

This standard provides a framework for a justifiable, transparent, and understandable means of articulating results and interpretations in the footwear and tire evidence discipline. This document defines terms, describes comparative observations and interpretations of data, and establishes model qualitative articulations for the range of results and interpretations that may be reached following footwear and tire evidence comparisons.

This standard does **not** cover the following topics:

- Results and interpretations derived directly from or entirely dependent upon probability models or quantitative methods.
- Determination of the relevant population for evaluation.
- Detailed guidelines and best practices for conducting examinations and comparisons of evidence.
- Detailed guidelines for documentation of comparisons and results/interpretations.
- Detailed guidelines for reporting and testifying.
- Results and interpretations derived from an assessment of the type or categorization of a single item.
- Results and interpretations derived from a comparison of two questioned impressions (without known footwear or tires).
- Results and interpretations derived from an assessment of the events or activities that produced the given evidence.
- Detailed guidelines for verification of these results and interpretations.

This standard is based upon practical experience, research, and resources available at the time of publishing. Published research¹ demonstrates that trained examiners are effective in conducting footwear and tire comparisons and reporting source opinions; however, these studies were not conducted specifically on this standard.

Further information and resources can be found on the OSAC Footwear and Tire Subcommittee website and the Academy Standards Board (ASB) website, including detailed guidelines and best practices for examination of footwear and tire evidence.

2 Terms and Definitions

For the purpose of this document, the following terms and definitions apply. Additional relevant terminology can be found in the most recent version of the document entitled “Terminology Used for Forensic Footwear and Tire Evidence” (ASB Technical Report 097) as well as in the OSAC Lexicon. Unless specified otherwise, definitions included in this document supersede those in other documents for the purposes of this standard.

¹ See bibliography for full references: Busey 2022, Hicklin 2023, Richetelli 2020a, Richetelli 2020b, Richetelli 2024, Speir 2020.

2.1

articulation

Communication or explanation of the examination and decision-making process to encompass observations and interpretations.

2.2

characteristics of use

Features that are acquired through the wearing/usage of shoes and tires, to include general wear, specific wear, Schallmach, and randomly acquired characteristics (RACs).

2.3

correspondence

An interpretation that observed similarities between compared items (e.g., questioned impressions and known footwear or tires) is in agreement.

2.4

discriminability or (distinctiveness)²

The property of an observed characteristic or an item of footwear or tire that distinguishes it from different sources.

2.5

dissimilarity (dissimilar)

An observation that characteristics have the appearance of being potentially different but do not meet the criteria for an exclusionary difference. This observation could be caused by numerous factors including but not limited to the impression-making process, factors prior to recovery, and/or the recovery process.

2.6

distinguishing characteristic(s)

Feature(s) on a footwear or tire, including manufacturing variables/defects and characteristics of use, that may be used to differentiate the item from others of the same class.

² The discriminability of a characteristic includes its shape, size, complexity, and reliability. The discriminability of an impression encompasses its features' quantity, spatial arrangement, quality, and rarity/perceived rarity.

2.7

exclusion

The known footwear or tire exhibits differences in class characteristics or distinguishing characteristics that indicate the footwear or tire did not make the questioned impression and thus is NOT part of the pool of potential sources for the questioned impression.

2.8

exclusionary difference

A difference in one or more characteristics between compared items that is substantial enough to determine that the compared items did not originate from the same source.

2.9

inclusion

The known footwear or tire exhibits similarities in class characteristics and/or distinguishing characteristics that indicate the footwear or tire may have made the questioned impression and thus is part of the pool of potential sources for the questioned impression.

2.10

item of evidence (“item”)

The object, sample, image, impression, or document being examined. Items may be from unknown or known sources.

2.11

measured rarity³

The prevalence of a feature or set of features observed in evidence estimated using representative databases, research, and/or manufacturing/distribution information. NOTE: very few (if any) such databases currently exist for practical use in footwear or tire evidence.

2.12

observation

Recognizing and noting an occurrence. For the purpose of this document, “occurrence” refers to features, attributes, and/or measurements.

³ Rarity (either measured or perceived) of the class characteristic of make/model and/or size of a footwear or tire refers to how often that type of feature is encountered in a group of footwear or tires (its prevalence), either in isolation or in conjunction with other information about its local context. Rarity of the location and degree of wear as well as the size and shape of randomly acquired characteristics refers to how frequently these types of features are encountered in a group of footwear or tires (their prevalence), either in isolation or in conjunction with other information about local context.

2.13

perceived rarity⁴

An examiner's assessment of the prevalence of a feature or set of features based upon his/her training, experience, and/or case factors, in the absence of data (as outlined under "*measured rarity*"). When perceived rarity is considered during the decision-making process, the examiner must clearly and thoroughly describe the information considered.

2.14

quality

A subjective measure of the character⁵ and fidelity⁶ of a questioned impression or known item of footwear or tire (including associated exemplars), both of which determine its value for comparison.

2.15

similarity (similar)

An observation that an impression and an item of footwear or tire share a likeness of details.

2.16

source

A specific item of footwear or tire from which an impression originates.

2.17

source opinion

An opinion in which an examiner is assessing the degree to which the evidence supports whether one (or more) item(s) came from a specified source (e.g., whether a tire impression came from a known tire or a different tire).

2.18

specific wear

Discrete wear on an item of footwear or tire that is more distinctive than general wear by virtue of its position, degree, and orientation (e.g., wear in atypical contact areas, Schallamach patterns).

⁴ Rarity (either measured or perceived) of the class characteristic of make/model and/or size of a footwear or tire refers to how often that type of feature is encountered in a group of footwear or tires (its prevalence), either in isolation or in conjunction with other information about its local context. Rarity of the location and degree of wear as well as the size and shape of randomly acquired characteristics refers to how frequently these types of features are encountered in a group of footwear or tires (their prevalence), either in isolation or in conjunction with other information about local context.

⁵ Character refers to the quantity of the source's features that are reproduced in the impression and the discriminability of those features.

⁶ Fidelity refers to the accuracy and clarity of the source's features as reproduced in the impression or exemplar.

3 Suitability Determinations

A suitability determination is a judgment made prior to comparison (i.e., prior to examining the known footwear or tire) of whether an item contains sufficient quality and value for a comparison.

3.1 Not Suitable for Comparison

A ***not suitable for comparison*** determination is a judgment that a more detailed examination is not warranted. The examiner determined there were minimal or no confirmable or discernable features present. This determination applies when there is insufficient detail to conduct any comparison.

3.2 Suitable for Comparison

A ***suitable for comparison*** determination is a judgment that a source opinion can potentially be reached. The examiner determined that the item contains sufficient observed data (e.g., sufficient quality and quantity of features, size, or condition of any evidence items) to be used for a comparison.

4 Articulation of Source Opinions

Source opinions are reported by forensic examiners to communicate the results and interpretations of their comparison and evaluation of two (or more) items of evidence. These items are generally categorized as one of two types: questioned footwear or tire impressions and known footwear or tires. These results and interpretations are derived using acquired knowledge, training, skills, and experience of the footwear and tire evidence examiner. Examiners should be mindful regarding the potential impact of human factors, including biases, when conducting their examinations and reaching source opinions. In reaching source opinions, an examiner evaluates the quality, quantity, and discriminability of characteristics in the evidence, the persistence of characteristics on the outsole/tread over time (if applicable), and the extent of similarities and dissimilarities of the observed characteristics, while taking into account the measured or perceived rarity of these observed characteristics and any potential limitations of the items. Potential limitations may include (but are not limited to):

- Distortion
- Improper recovery methods
- Photographic issues
- Time delay between deposition and collection

Examiners shall assess the strength of evidence by considering the prospect of encountering the observed combination of characteristics if the questioned impression was made by the known footwear or tire, relative to the prospect of finding the observed combination of characteristics if the questioned impression was made by a different source. The size of the pool of other

potential sources is typically unknown, but can be expected to decrease as the number and type of features in correspondence increases.

Examiners shall state their opinions in documentation, reporting, and testimony using the full articulations below, not merely using the category labels (e.g., “support for source exclusion”). Examiners should provide the entire articulation scale in their documentation and reporting, as shown in Figure 1. In particular, examiners shall state their opinions in terms of the support for their observations and interpretations given the following two propositions:

- The known item of footwear or tire made the questioned impression (known source)
- A different item of footwear or tire made the questioned impression (different source)

Figure 1 shows the articulation categories for footwear and tire interpretations. The following descriptions are meant to provide context to the levels of opinions reached in footwear and tire impression comparisons. The descriptions of each level are not intended to be all inclusive for every possible observation. Each source opinion is broken down into the required observations, the appropriate interpretations of said observations, and the necessary articulation to report the given opinion.

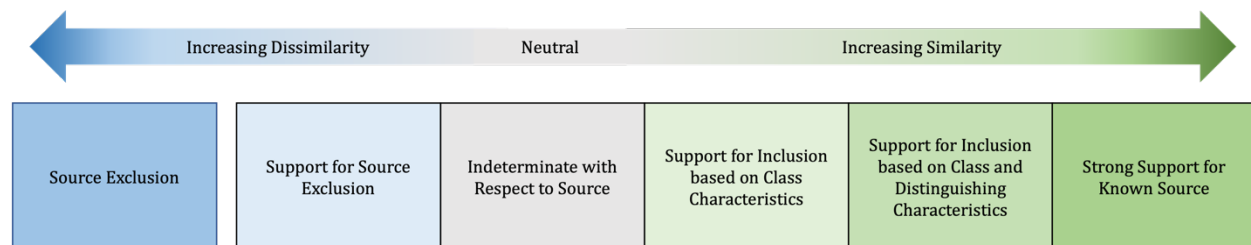


Figure 1 Articulation of source opinions for footwear and tire interpretations. The source opinion categories are displayed as concrete bins across a continuum of observed similarity/dissimilarity.

4.1 Source Exclusion

4.1.1 Observations

One or more exclusionary differences were noted in the comparison of class characteristics and/or distinguishing characteristics between the questioned impression and the known footwear or tire. Dissimilarities may also be observed.

4.1.2 Interpretation

Source exclusion is an examiner’s opinion that the observed characteristics provide extremely strong support for the proposition that a different footwear or tire made the questioned impression *and* no support for the proposition that the known footwear or tire made the questioned impression.

Source exclusion is expressed using absolutes because there is a logical impossibility that the items came from the same source (e.g., an outsole design composed of zig zags and circles can be definitively excluded as the source of an impression in which only square blocks are apparent). In this scenario, an opinion of source exclusion represents a posterior odds statement in which there is no support for the proposition that the known footwear or tire made the questioned impression.

Characteristics of use should only be used as the sole observation in forming an opinion of source exclusion if the questioned and known items differ significantly in the quality and quantity of characteristics of use and either the known footwear or tire is recovered shortly after the deposition of the impression, the fact that the known item has not changed between deposition and recovery can otherwise be verified, or the nature of the characteristics of use logically preclude alternative findings.

4.1.3 Articulation

One or more exclusionary differences were noted in the comparison of class characteristics and/or distinguishing characteristics between the questioned impression and the known footwear or tire to state that the prospect of finding the observed characteristics, if the two items came from the same source, is negligible.

The examiner shall explicitly detail observations and interpretations regarding:

- The specific class characteristics and/or distinguishing characteristics observed in the questioned impression versus the known footwear or tire.
- Any observed similarities between these characteristics.
- Any observed dissimilarities between these characteristics, why these were interpreted to be exclusionary differences, and why they were determined to be sufficiently strong to report **source exclusion**.
- The limiting factors that were encountered during the examination and how these limitations were accounted for, evaluated, and/or mitigated.

4.2 Support for Source Exclusion

4.2.1 Observations

The questioned impression exhibits dissimilarities in class characteristics and/or distinguishing characteristics when compared to the known footwear or tire. No exclusionary differences are observed.

4.2.2 Interpretation

Support for source exclusion is an examiner's opinion that there are limitations associated with the observed characteristics or evidence (e.g., quality, quantity, availability) that prevent the examiner from reaching a stronger exclusion but provide support for the proposition that a

different footwear or tire made the questioned impression and weak support for the proposition that the known footwear or tire made the questioned impression.

An opinion of support for source exclusion may be reached if (i.) there are observed dissimilarities in class characteristics and/or distinguishing characteristics **and** (ii.) one or more limiting factors, such as:

- The questioned impression is partial, fragmented, or distorted.
- The quality of the evidence is poor or lacking (e.g., low clarity, damage to the known footwear or tire or the questioned impression, improper photographic techniques, etc.).
- The time between the deposition of the impression and the recovery of the known footwear or tire may not account for the dissimilarities observed.
- The examiner does not have access to the known footwear or tire (and only has photographs and/or limited test impressions).

4.2.3 Articulation

The questioned impression exhibits dissimilarities when compared to the known footwear or tire and provides stronger support for the proposition that the questioned impression came from a different source than the proposition that the questioned impression came from the known footwear or tire.

The examiner shall explicitly detail observations and interpretations regarding:

- The specific class characteristics and/or distinguishing characteristics observed in the questioned impression versus the known footwear or tire.
- Any observed similarities between these characteristics.
- Any observed dissimilarities between these characteristics.
- Why any observed dissimilarities were interpreted not to be exclusionary differences.
- The limiting factors that were encountered during the examination and how these limitations were accounted for, evaluated, and/or mitigated.

4.3 Indeterminate with Respect to Source

4.3.1 Observations

Although the evidence items were determined to be suitable for comparison, there are significant limiting factors in the questioned impression and/or known footwear or tire. These factors may include, but are not limited to: partial, fragmented or distorted impression, insufficient information, lack of scale, improper position of scale, improper photographic techniques, differences between the region of the footwear or tire represented in the impression and the submitted known footwear or tire, the number of known footwear or tire items submitted of the same class and their lack of discriminating characteristics, or significant length of time between the date of the occurrence and when the footwear or tires were recovered that could account for a different degree of general wear. No exclusionary differences are observed.

4.3.2 Interpretation

Indeterminate with respect to source is an examiner's opinion that the observed characteristics are insufficient or too ambiguous to support any source opinions (as defined in the other sections).

In the opinion of the examiner, there was insufficient information and/or significant limiting factors observed in the questioned impression to warrant a meaningful opinion regarding the particular known footwear outsole or tire tread. This opinion only applies to the known footwear or tire that was examined and does not necessarily preclude future examinations with other known footwear or tires.

4.3.3 Articulation

The questioned impression does not exhibit sufficient observable similarities or dissimilarities when compared to the known footwear or tire to provide support for either proposition. The observations provide relatively equivalent support for both known source and different source propositions.

The examiner shall explicitly detail observations and interpretations regarding:

- The specific class characteristics and/or distinguishing characteristics observed in the questioned impression.
- How the observed characteristics in the questioned impression compare to those observed on the known footwear or tire.
- Any observed similarities and/or dissimilarities between these characteristics and why these were determined to be insufficient to provide stronger support for inclusion or exclusion.
- The limiting factors that were encountered during the examination.

4.4 Support for Inclusion Based on Class Characteristics

4.4.1 Observations

The class characteristics of design and physical size (if available) correspond between the questioned impression and the known footwear or tire. Correspondence of general wear may also be observed. Factors limiting the comparison and/or dissimilarities may also be observed. No exclusionary differences are observed.

4.4.2 Interpretation

Support for inclusion based on class characteristics is an examiner's opinion that the observed characteristics provide more support for the proposition that the questioned impression was made by the known footwear or tire than for the proposition that the questioned impression was made by a different footwear or tire. However, the relative support does not rise to the level

required for a stronger support for inclusion (based upon distinguishing characteristics) for the known footwear or tire.

Any other footwear or tire that shares the same class characteristics and general wear observed in the questioned impression are also included in the pool of possible sources.

Limiting factors may be present, such as: limited detail, insufficient RACs, improper photographic techniques, distortion, or significant lengths of time between the date of the occurrence and when the footwear or tires were recovered that could account for dissimilar characteristics of use.

Any observed dissimilarities shall be interpreted as explainable by the examiner (i.e., no exclusionary differences are observed).

4.4.3 Articulation

The questioned impression and known footwear or tire correspond in class characteristics (design and size, if available). Correspondence of general wear may also be observed. The observed characteristics of the items provide more support for the proposition that the questioned impression was made by the known footwear or tire than for the proposition that the questioned impression came from a different source.

Other footwear or tires with the class characteristics observed in the impression are included as possible sources. If general wear is observed in the questioned impression, any differences in general wear with the known shall be explainable by case circumstances (e.g., time delay between deposition and collection).

The examiner shall explicitly detail observations and interpretations regarding:

- The class characteristics observed in the questioned impression and the known footwear or tire.
- Any observed similarities between these characteristics and why these were interpreted to be correspondences.
- Any observed dissimilarities between these characteristics and why these were interpreted to be explainable.
- The limiting factors that were encountered during the examination and how these limitations were accounted for, evaluated, and/or mitigated.

4.5 Support for Inclusion Based on Class and Distinguishing Characteristics

4.5.1 Observations

The questioned impression and known footwear or tire correspond in all observed class characteristics (design and size). Correspondence of general wear and/or manufacturing variables/defects may also be observed. There is also specific wear and/or one or more randomly

acquired characteristic(s) in correspondence. Factors limiting the comparison and/or dissimilarities may also be observed. No exclusionary differences are observed.

4.5.2 Interpretation

Support for inclusion based on class and distinguishing characteristics is an examiner's opinion that the observed characteristics provide substantially more support for the proposition that the questioned impression was made by the known footwear or tire than for the proposition that the questioned impression was made by a different footwear or tire. However, the relative support does not rise to the level required for **strong support for known source**.

Any other footwear or tire that shares the same class characteristics and distinguishing characteristics observed in the questioned impression are also included in the pool of possible sources.

Limiting factors may be present, such as: limited detail, insufficient RACs, improper photographic techniques, distortion or significant lengths of time between the date of the occurrence and when the footwear or tires were recovered that could account for dissimilar characteristics of use.

Any observed dissimilarities shall be interpreted as explainable by the examiner (i.e., no exclusionary differences are observed).

4.5.3 Articulation

The questioned impression and the known footwear or tire share agreement of all class characteristics and one or more distinguishing characteristics. These corresponding characteristics offer substantially more support for the proposition that the questioned impression came from the known footwear or tire than for the proposition that the questioned impression came from a different source.

Other footwear or tires with the same class characteristics observed in the impression are included in the pool of possible sources **only if** they display the same distinguishing characteristics observed in the questioned impression.

The examiner shall explicitly detail observations and interpretations regarding:

- The class characteristics and distinguishing characteristics observed in the questioned impression and the known footwear or tire.
- Any observed similarities between these characteristics and why these were interpreted to be correspondences.
- Explanation of why the observed similarities and correspondences were not sufficient to report **strong support for known source**.
- Any observed dissimilarities between these characteristics and why these were interpreted to be explainable.

- The limiting factors that were encountered during the examination and how these limitations were accounted for, evaluated, and/or mitigated.

4.6 Strong Support for Known Source

4.6.1 Observations

The questioned impression and the known footwear or tire correspond in all observed class characteristics and distinguishing characteristics, including one or more randomly acquired characteristics of high quality and combined discriminability. Minor dissimilarities may also be observed. No exclusionary differences were observed.

4.6.2 Interpretation

Strong Support for Known Source is an examiner's opinion that the observed characteristics provide overwhelmingly more support for the proposition that the questioned impression was made by the known footwear or tire than for the proposition that the questioned impression was made by a different footwear or tire. There is extremely weak support for the proposition that the questioned impression was made by a different footwear or tire.

This opinion shall not be expressed using absolutes such as "to the exclusion of all other sources" or "100% certainty." Other footwear or tires with the same class characteristics and distinguishing characteristics observed in the questioned impression are included in the pool of possible sources — which is exceedingly small in the opinion of the examiner given the quantity, quality, and discriminability of the observed corresponding characteristics.

Any observed dissimilarities shall be interpreted as explainable by the examiner (i.e., no exclusionary differences are observed).

4.6.3 Articulation

The questioned impression and the known footwear or tire share agreement of class characteristics and distinguishing characteristics, including one or more RACs of high quality and/or discriminability. The observed characteristics provide overwhelmingly more support for the proposition that the questioned impression came from the known footwear or tire than for the proposition that the questioned impression came from a different source.

The examiner shall explicitly detail observations and interpretations regarding:

- The specific class characteristics and distinguishing characteristics observed in the questioned impression and the known footwear or tire
- Any observed similarities between these characteristics and why these were interpreted to be correspondences.
- Explanation of why the observed similarities and correspondences were sufficiently strong to report **strong support for known source**.

- Any observed dissimilarities between these characteristics and why these were interpreted to be explainable.
- The limiting factors that were encountered during the examination and how these limitations were accounted for, evaluated, and/or mitigated.

5 General Considerations

Proper documentation of the source opinions detailed herein provides transparency and aids in the interpretation of the results. Documentation of an examiner's observations and findings should be balanced, logical, robust, thorough, and transparent and shall explicitly describe the bases for conclusions, acknowledging limitations of the information available to the examiner, and disclosing contextual information or assumptions (if any) used to make conclusions. All source opinions require such documentation.

All source opinions outlined in this document, with the exception of **Source Exclusion**, refer to whether evidence supports the known source or different source propositions. These opinions do not refer to the chances that evidence items originate from a known source or from a different source. This is beyond the scope of the examiner's responsibilities. An opinion of **Source Exclusion** is the only category that permits communicating opinions in absolutes and reflects a statement about the truth of the different source proposition: there is no support for the proposition that the known footwear or tire made the questioned impression.

6 Qualifications and Limitations

When articulating footwear and tire interpretations in reports and testimony, the examiner shall adhere to the following limitations, unless specifically prohibited from doing so during judicial proceedings:

- A source opinion provided in a report or during testimony is ultimately an examiner's opinion and is not based upon a comparison to all other footwear or tire items.
- An examiner shall not assert that a "strong support for known source" is based on the "uniqueness" of an item of evidence.
- An examiner shall not use the terms "individualize", "individualization", "identification", or "match" when describing a source opinion.
- An examiner shall not assert that a known item made an impression with absolute or 100% certainty or use the expressions "reasonable degree of scientific certainty," "reasonable scientific certainty," or similar assertions of reasonable certainty in either reports or testimony.
- An examiner shall not assert that a known item made an impression to the exclusion of all other footwear or tires.
- An examiner shall not provide an "inclusion" opinion without explaining that other footwear or tires with similar characteristics could have also made the impression(s).
- An examiner shall not assert or infer that footwear or tire examinations are infallible or have a zero-error rate.

- An examiner shall not provide an opinion that includes a numerical estimate of probability or a statistically derived measurement except when based on appropriate data.
- An examiner shall qualify any statements of feature rarity or prevalence by explicitly specifying the data used (if available) or acknowledging the subjectivity in the estimation of perceived rarity.
- An examiner shall not cite the number of forensic footwear or tire examinations performed in their career as a direct measure for the accuracy of a reported opinion.

Annex A

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