# OSAC PROPED STANDARD 2026-N-1041

# Standard for Terrestrial LiDAR Scan Data Processing

Crime Scene Investigation and Reconstruction Subcommittee
Scene Examination Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science

## Draft OSAC Proposed Standard

# OSAC 2026-N-1041
# Standard for Terrestrial LiDAR Scan Data Processing

Prepared by
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**Foreword**

This document delineates standards and recommendations for the processing of data captured using a terrestrial LiDAR scanner (TLS) during scene documentation. The approach outlined is recommended as good professional practice even though the facts and issues of each situation require specific considerations, and may involve matters not expressly dealt with herein. Not every portion of this document may be applicable to every incident or investigation. It is up to the individual processing the data to apply the appropriate recommended procedures in this guide to a particular incident or investigation. In addition, it is recognized that time and resource limitations may limit the degree to which the recommendations in this document will be applied in a given investigation. The responsibility of the individual processing the data for subsequent visualization and/or analysis, and the scope of that responsibility varies based on such factors as the jurisdiction, the status of the individual as a public official or private sector investigator, indication of criminal conduct, and applicable laws and regulations. This document shall be utilized in conjunction with local regulations and any requirements set forth by entities processing TLS data to inform or augment policies relating to the collection and preservation of physical evidence.

This standard draws heavily from and takes language verbatim from the Forensic Technology Center of Excellence (2022), Guidelines for the use of terrestrial LiDAR scanners in criminal justice applications, U.S. Department of Justice, National Institute of Justice, Office of Investigative and Forensic Sciences supported by Award No. 2016-MU-BX-K110, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice.

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

**Keywords:** *processing; data; terrestrial LiDAR scanner; TLS; 3D scanning; terrestrial laser scanner; scene documentation; scene diagramming*

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**Standard for Terrestrial LiDAR Scan Data Processing**

## 1 Scope

This document establishes guidelines for the processing of terrestrial LiDAR data acquired during forensic scene documentation. It defines practices for importing, registering, editing, and exporting point cloud data and generating outputs that support forensic analysis, visualization, and courtroom presentation. If compliance with this standard is claimed, justification for any deviation from this standard shall be documented.

## 2 Normative References

The following references are indispensable for the application of the standard. For dated references, only the edition cited applies. The latest edition of the referenced document (including any amendments) applies for undated references.

**2.1** ANSI/ASB Standard 159, Standard for Scene Investigation and Reconstruction—Foundational Principles

**2.2** OSAC Proposed Standard 2023-N-0002, Standard for Scene Documentation Procedures

**2.3** OSAC Proposed Standard 2023-N-0003, Standard for Diagramming Scenes

**2.4** OSAC Proposed Standard 2025-N-0022, Standard for Terrestrial LiDAR Scanner Data Capture

## 3 Terms and Definitions

For the purposes of this document, the following definitions and acronyms apply:

**3.1**
**accuracy (of measurement)**
the closeness of the agreement between the result of a measurement and a true value of the measurand. (ANSI/ASTM E2544-24)

**3.2**
**artificial common reference object**
strategically placed objects (e.g., spherical, checkerboard, retroreflective, or coded markers), in the scan area to serve as reference points between scan positions to enable registration or for measurements; also referred to as "target(s)." (FTCoE, 2022; modified)

**3.3**
**cloud-to-cloud registration**
**C2C**
see "targetless registration."

**3.4**
**error (of measurement)**
result of a measurement minus a true value of the measurand. (ANSI/ASTM E2544-24)

**3.5**
**known-length artifact**
an item with a known size that is introduced into the scan area to allow for an accuracy check of the individual scan data. (FTCoE, 2022)

**3.6**
**light detection and ranging (LiDAR)**
a remote sensing technology that measures distance by illuminating a target and analyzing the reflected light. (RTI International, 2016; modified)

**3.7**
**mesh**
a digital representation of an object's three-dimensional surface, defined by its vertices, edges, and faces.

**3.8**
**outlier(s)**
a 3D point or group of points within a point cloud that does not represent actual physical features in a scene and is likely caused by environmental conditions, e.g., reflections, refractions, moving objects, or instrument limitations; also referred to as "noise."

**3.9**
**point**
an abstract concept describing a location in space which is specified by its coordinates and other attributes. (ANSI/ASTM E2544-24)

**3.10**
**point cloud**
a collection of data points in 3D space (frequently in the hundreds of thousands), for example as obtained using a 3D imaging system. (ANSI/ASTM E2544-24)

**3.11**
**registration**
the process of determining and applying to two or more data sets, the transformations that locate each dataset in a common coordinate system so that the datasets are aligned relative to each other. (ANSI/ASTM E2544-24)

**3.12**
**target(s) (*n*)**
see "artificial common reference object."

**3.13**
**target-based registration**
a method of aligning multiple 3D scans using artificial common reference objects (e.g., spheres, checkerboards, or coded markers) that are placed within the scene and captured by the scanner from multiple positions. The known geometric properties and spatial relationships of these

targets are used to compute the relative position and orientation of each scan; also referred to as "targeted registration."

**3.14**
**targetless registration**
a method of aligning multiple 3D scans by identifying and matching overlapping geometry or features common to each scan, without the use of artificial common reference objects. This technique relies on the inherent and unique geometric structure of the scanned environment to compute the relative position and orientation of each scan; also referred to as "cloud-to-cloud registration."

**3.15**
**terrestrial LiDAR scanner (TLS)**
an instrument that is used for 3D mapping tasks that acquire complex geometric data from a static position, typically mounted on a tripod, where each point is determined by the position (x, y, z) and the intensity (i) of the returning signal; also referred to as "terrestrial laser scanner." (RTI International, 2016; modified)

NOTE: terrestrial refers to or relating to land as distinct from air or water. (Miriam Webster, 2022)

## 4 Scan Data Processing Overview

**4.1** ANSI/ASB Standard 159, Standard for Scene Investigation and Reconstruction—Foundational Principles, OSAC Proposed Standard 2023-N-0002, Standard for Scene Documentation Procedures, OSAC Proposed Standard 2023-N-0003, Standard for Diagramming Scenes, and OSAC Proposed Standard 2025-N-0022, Standard for Terrestrial LiDAR Scanner Data Capture shall be used in conjunction with this document. OSAC Proposed Standard 2023-N-0002 provides general standards for the documentation of scenes, upon which additional specific requirements, such as this document, will be based. OSAC Proposed Standard 2023-N-0003 provides more specific standards for the diagramming of scenes, and applies directly to this document, as terrestrial laser scanning is a specific form of scene diagramming. OSAC Proposed Standard 2025-N-0022 provides guidelines for the proper capture of terrestrial laser scan data to be processed.

**4.2** While the specific scope of processing may vary depending on the case, Forensic Science Service Providers (FSSPs) shall develop agency-specific operating procedures that ensure all processing actions are documented and repeatable. These steps shall be executed in a manner that maintains the integrity and traceability of the original data.

**4.3** While the original LiDAR data shall always be preserved, the specific details regarding the preservation of original laser scan data is outside the scope of this document and will be covered in a separate document.

## 5 Import

**5.1** TLS project data shall be imported into manufacturer-recommended or validated third-party software prior to processing. After import, the user shall verify that all expected scans have been successfully transferred and that no data has been corrupted or lost.

**5.2** Any scans not included in the project and/or final products (e.g., incomplete scan, corrupted file, scan data not within the scope of the project) shall be documented in the case record.

## 6 Filtering / Editing

**6.1** There are additional steps that may be taken to modify the point cloud, either to apply color, to enhance color, to remove extraneous points, or filtering the point cloud by distance or point spacing. These modifications can be accomplished at any point from data import to export.

**6.2** When reviewing scan data, points that do not reflect static scene geometry, such as people, vehicles, and other transient objects or artifacts (e.g., reflections, edge artifacts) may be removed. These removals serve to enhance scene clarity but shall not result in the loss of potential evidentiary information.

**6.3** If the user applies one or more filters that modify the point cloud in any way, the user shall understand how these settings affect data fidelity and select options appropriate for the intended use of the data. Import settings and parameters as well as any data filtering or editing shall be documented as part of the case record.

**6.4** If extraneous data points or outliers were removed, a statement such as the following shall be included in reports or presentations: "To enhance clarity, extraneous data points—such as those resulting from movement, reflections, or environmental noise—were removed. The original unaltered data have been preserved and are available upon request."

## 7 Registration

**7.1** Point cloud registration aligns all scan positions into a common coordinate system. The method of registration may include targetless or target-based, or a hybrid of both, depending on the scanned environment.

**7.2** After alignment, users shall review the registration report provided by the software and perform a visual inspection of the point cloud to verify accurate alignment of overlapping surfaces and features. The decision to accept or re-register the data will be based on the intended purpose of the scan data, as delineated in OSAC Proposed Standard 2025-N-0022 Standard for Terrestrial LiDAR Scanner Data Capture, wherein it describes the types of forensic TLS applications, each with distinct accuracy, resolution and evidentiary requirements. For example, a less accurate registration result may be acceptable for general scene documentation, whereas a more accurate registration result may be required for critical evidence documentation.

**7.3** If the reported registration error exceeds acceptable limits, the user shall determine if an adjustment to the registration parameters is necessary, if additional filtering is needed to achieve a more accurate registration (e.g. object movements between scan positions), or if manual registration is a better option.

**7.4** Any manual alignment or positioning of scan data shall be documented by the user to include the rationale for manual placement of scan data.

## 8 Known-Length Artifact Verification

**8.1** Any known-length artifacts that have been introduced into the scene during data capture, shall be reviewed to ensure that the artifact is clearly visible and that it was captured from at least one scan position with sufficient point density to allow for accurate measurement. This verification process provides a practical check of dimensional accuracy in the point cloud.

**8.2** Measurements shall be taken between the clearly defined points on the artifact within an individual scan using either the TLS manufacturer's software or a validated third-party tool. If the known-length artifact is a certified artifact, the measured distance shall then be compared to the certified length of the artifact, as documented in certification records. If the artifact is not certified, the measured value shall be compared with the known length of the artifact (e.g., measurement demarcations along a yardstick). The FSSP shall determine acceptable deviation limits based on the TLS specifications and the intended purpose of the scan data (e.g. general scene vs critical evidence documentation).

**8.3** If the deviation exceeds acceptable limits, the user shall determine whether the error is due to instrument limitations or environmental conditions. In such cases, corrective actions shall be considered, such as revising point selection for measurement. All measurement results, including the comparison with the known or certified length and any corrective actions taken, shall be documented in the processing log or final report. Measurements of known-length artifacts obtained within point cloud data software shall be retained as part of the case record. These measurements may be documented through screenshots or equivalent visual representations.

**8.4** This measurement verification does not replace full instrument calibration procedures but serves as an additional measure of quality control within the documentation workflow.

## 9 Data Export

**9.1** Processed point clouds may be exported in formats compatible with downstream analysis and tools and maintain spatial accuracy of the final dataset. Common export formats that support wide interoperability include but are not limited to: E57, PTS/PTX, XYZ, LAS/LAZ, and TXT.

**9.2** When converting point cloud data into mesh formats (e.g., OBJ, PLY), users shall compare the resulting surface with the original point cloud. Meshing can introduce artifacts or smooth over important details, potentially misrepresenting the true surface geometry. It's important to understand whether any analysis is based on raw LiDAR points or an interpolated mesh, as this affects the accuracy and reliability of measurements.

## 10 Output/Deliverables

**10.1** Deliverables generated from TLS data or their associated reports shall include appropriate contextual information such as:

- the measurement system (e.g., metric or imperial),
- scale factor or graphic scale,
- orientation indicators (e.g., coordinate system, north arrow, or compass rose),
- and a clear legend or key.

**10.2** These products may include, but are not limited to:

- 2D diagrams,
- orthographic projections,
- 3D scene visualizations,
- animations,
- immersive technologies (virtual, augmented, and mixed reality),
- or physical and/or 3D printed models.

**10.3** The form and complexity of deliverables shall be determined by the needs of the investigation, the intended use of the data (e.g. general scene vs critical evidence documentation), and any presentation requirements.

## 11 Quality Assurance

**11.1** FSSPs shall develop and implement internal quality assurance procedures for TLS data processing. These procedures shall include a technical review of registration quality and final products.

# Annex A
(informative)

## Bibliography

This is not meant to be an all-inclusive list, as the group recognizes other publications on this subject may exist. When this document was drafted, these were some of the publications available for reference. Also, any mention of a particular hardware or software tool or vendor as part of this bibliography is purely incidental, and any inclusion does not mean that the authors of this document are endorsing it.

1) Bruce, S., Possolo, A. and Watters, R. (2021), Metrological Traceability Frequently Asked Questions and NIST Policy, Technical Note (NIST TN), National Institute of Standards and Technology, Gaithersburg, MD, [online], https://doi.org/10.6028/NIST.TN.2156, https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=932360 (Accessed April 10, 2025)

2) Forensic Technology Center of Excellence. (2022). Guidelines for use of terrestrial LiDAR scanners in criminal justice applications. U.S. Department of Justice, National Institute of Justice, Office of Investigative and Forensic Sciences. https://forensiccoe.org/private/623892c74fbb6

3) ASTM International. (2019). ANSI/ASTM E2544—24: Standard Terminology for Three-Dimensional (3D) Imaging Systems. https://doi.org/10.1520/E2544-11AR19

4) Dang, Q. (2012). NIST Special Publication 800-107 Revision 1: Recommendation for Applications Using Approved Hash Algorithms. National Institute of Standards and Technology. https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=911479

5) Joint Committee for Guides in Metrology (JCGM). (2012). International vocabulary of metrology—Basic and general concepts and associated terms (VIM) (JCGM 200:2012) (3rd ed). https://www.bipm.org/documents/20126/2071204/JCGM_200_2012.pdf

6) RTI International. (2016). Landscape study on 3D crime scene scanning devices. National Institute of Justice, Forensic Technology Center of Excellence. https://forensiccoe.org/private/5dd6ad2d0ffeb

7) International Standards Organization. (2018). ISO 17123-9: Optics and optical instruments—Field procedures for testing geodetic and surveying instruments—Part 9: Terrestrial laser scanners. https://www.iso.org/standard/68382.html

8) International Standards Organization. (2017). ISO 9849-2017: Optics and optical instruments-Geodetic and surveying instruments-Vocabulary. https://www.iso.org/standard/65084.html

9) Boardman, C., Bryan, P., McDougall, L., Reuter, T., Payne, E., Moitinho, V., Rodgers, T., Honkova, J., O'Connor, L., Blockley, C., Andrews, D., Bedford, J., Sawdon, S., Hook, L., Green, R., Price, K. Klÿn, N., & Abbott, M. (2018). 3D laser scanning for heritage. advice and guidance on the use of laser scanning in archaeology and architecture (3rd ed.). Historic England. https://historicengland.org.uk/images-books/publications/3d-laser-scanning-heritage/heag155-3d-laser-scanning.pdf

10) National Institute of Standards and Technology. (2018). Traceability table of contents. https://www.nist.gov/traceability/traceability-table-contents

11) Scientific Working Group on Digital Evidence. (2020). SWGDE best practices for maintaining the integrity of imagery. https://drive.google.com/file/d/1ZnPLfg2lsbY7lyikQZCn52B8AcJ9ZjmL/view.

12) Scientific Working Group on Digital Evidence. (2019). SWGDE position on the use of MD5 and SHA1 hash algorithms in digital and multimedia forensics. https://www.swgde.org/documents/positions-and-considerations