



TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Microanalysis Standard Operating Procedures Manual

Physical Analysis and Comparison

Physical Analysis and Comparison

1. Scope

The purpose of a physical comparison is to associate or dissociate two or more items using individual characteristics (fracture matches/physical fit) or class characteristics (e.g. size, construction, physical properties).

The purpose of a physical analysis is to document physical properties or other characteristics that could be used for identification purposes.

2. Terms and Definitions

Fracture or Physical Match - The examination of two or more objects that have been cut, torn, or broken using physical, optical, and photographic means, which allows one to conclude that these objects were at one time one entity.

Physical fit – an association based upon the realignment of two or more items that demonstrate they were once joined together to form a single object.

Hackle marks – fine ridges on a fracture surface.

Striations – distinct lines on a fracture surface that may be related to crack progression through the material.

3. References

Richard Saferstein Criminalistics 6th Edition Prentice Hall 1998.

ASTM International, "Standard Guide for Physical Match of Paper Cuts, Tears, and Perforations in Forensic Document Examinations," E 2288.

Bradley, M. J., Gauntt, J. M., Mehlretter, A. H., Lowe, P. C., Wright, D. M., "A Validation Study for Vinyl Electrical Tape End Matches," *Journal of Forensic Sciences*, Vol. 56, No. 3, May 2011, pp. 606-611.

Bradley, M. J., Keagy, R. L., Lowe, P. C., Rickenbach, M. P., Wright, D. M., LeBeau, M. A., "A Validation Study for Duct Tape End Matches," *Journal of Forensic Sciences*, Vol. 51, No. 3, May 2006, pp. 504-508.

Johnston, J., Manufacturing Methods. [ASTETrace.org/Resources/Tape Subgroup](https://www.astetrace.org/Resources/Tape%20Subgroup)



TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Microanalysis Standard Operating Procedures Manual

Physical Analysis and Comparison

Katterwe, H. W., "Fracture Matching and Repetitive Experiments: A Contribution of Validation," *AFTE Journal*, Vol. 37, No. 3, Summer 2005, pp. 229-241.

Klein, A., Nedivi, L., Silverwater, H., "Physical Match of Fragmented Bullets," *Journal of Forensic Sciences*, Vol. 45, No. 3, 2000, pp. 722-727.

Lau, Y. M. S., "Physical Match: Unique Fracture Patterns in Wooden Popsicle Sticks," *Themis: Research Journal of Justice Studies and Forensic Science*, Vol. 5, Article 9, 2017.

Laux, D. L., "Identification of a Rope by Means of a Physical match Between the Cut Ends," *Journal of Forensic Sciences*, JFSCA, Vol. 29, No. 4, Oct. 1984, pp. 1246-1248.

Miller, J., Kong, H., "Metal Fractures: Matching and Non-Matching Patterns," *AFTE Journal*, Vol. 38, No. 2, Spring 2006, pp. 133-165.

Ogle, R. R., Mitosinka, G. T., Crim, M., "The Identification of Cut Multistranded Wires," *Journal of Forensic Sciences*, Vol. 19, No. 4, Oct. 1974, pp. 865-867.

Orench, J. A., "A Validation Study of Fracture Matching Metal Specimens Failed in Tension" *AFTE Journal*, Vol. 37, No. 2, Spring 2005, pp. 142-149.

OSAC, "Standard Guide for Forensic Physical Fit Examination," OSAC 2022-S-0015.

Schubert, G., "Fabric Impressions Results and Testimony," PowerPoint PDF, Illinois State Police.

Scientific Working Group for Materials Analysis (SWGMAT), "Guideline for Forensic Examination of Pressure Sensitive Tapes," *Journal of the American Society of Trace Evidence Examiners*, Vol. 2, Issue 1, 2011.

Scientific Working Group for Materials Analysis (SWGMAT), "Guideline for Assessing Physical Characteristics in Forensic Tape Examinations," *Journal of the American Society of Trace Evidence Examiners*, Vol. 2, Issue 1, 2011.

Scientific Working Group for Materials Analysis (SWGMAT), "Guideline for Using Light Microscopy in Forensic Examinations of Tape Components."

Scientific Working Group for Materials Analysis (SWGMAT), "Standard Guide for Using Fourier Transform Infrared Spectroscopy in Forensic Tape Examinations."



TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Microanalysis Standard Operating Procedures Manual

Physical Analysis and Comparison

Shor, Y., Kennedy, R. B., Tsach, T., Volkov, N., Novoselsky, Y., Vinokurov, A., "Physical Match: Insole and Shoe," *Journal of Forensic Sciences*, Vol. 48, No. 4, July 2003, pp. 1-3.

Shor, Y., Novoselsky, Y., Klein, A., Lurie, D. J., Levi, J. A., Vinokurov, A., Levin, N., "The Identification of Stolen Paintings Using Comparison of Various Marks," *Journal of Forensic Sciences*, Vol. 47, No. 3, 2002, pp. 633-637.

Smith, J., "Part I polymers in Tape Products, Part II PLM of Clear Polymer Films," PowerPoint PDF, Missouri State Highway Patrol Crime Lab.

VanHoven, H. A. and Fraysier, H. D., "The Matching of Automotive Paint Chips by Surface Striation Alignment," *Journal of Forensic Sciences*, JFSCA, Vol. 28, No. 2, April 1983, pp. 463-467.

Von Bremen, U. G., Blunt, L. K. R., "Physical Comparison of Plastic Garbage Bags and Sandwich Bags," *Journal of Forensic Sciences*, JFSCA, Vol. 28, No. 3, July 1983, pp. 644-654.

Zugibe, F. T. and Costello, J. T., "The Jigsaw Puzzle Identification of a Hit-and-Run Automobile," *Journal of Forensic Sciences*, JFSCA, Vol. 31, No. 1, Jan. 1986, pp. 329-332.

4. Examination Procedures

4.1. Evidence Types

Evidence that appears to have been cut, torn, or broken, or other like items. This includes, but is not limited to: automobile parts, paper, matches, glass, fabric and cordage, buttons, items of clothing, tapes, fabric impressions, and impressions made by anything other than footwear or tires.

4.2. Instruments and Equipment

Stereomicroscope
Comparison microscope
Calipers
Magnifying glass
Photographic equipment and accessories
Fingerprint powder and brush

TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Microanalysis Standard Operating Procedures Manual

Physical Analysis and Comparison



Adhesive acetate paper
Non-adhesive acetate paper
Ruler
Biofoam
Clay
Casting material
Sample handling tools (e.g., probe, forceps)
Tape
Fourier Transform Infrared Spectrometer (FTIR)
Attenuated Total Reflectance Spectrometer (ATR)
Scanning Electron Microscope/Energy Dispersive X-Ray Spectrometer (SEM/EDS)

4.3. Limitations

A fracture match may not be possible among like items if all the pieces are not submitted.

If a physical comparison is not possible, a physical analysis may be performed.

4.4. Procedure

Document submitted samples according to *Microanalysis Quality Assurance Policy*.

4.4.1 Physical Comparison:

Evidence submitted may be photographed for case file documentation.

Examine the items to see if the edges of the questioned and standard pieces fit together like a jigsaw puzzle. Matching hackle marks and defects should also be examined to reinforce the physical fit.

If a fracture match is possible, all matches must be photographed. All matches should be labeled; however, if this is not possible due to size, photographs should be representative of before and after the match and the unlabeled items shall be described in the case notes. All fracture matches will be verified by a qualified examiner. This will be recorded by initialing next to the results in the case folder.

TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Microanalysis Standard Operating Procedures Manual

Physical Analysis and Comparison



If a test impression is necessary, follow the procedure for acquiring test impressions in Microanalysis Standard Operating Procedure *Footwear Impression Analysis and Comparison*. This same technique can be used for other items such as keys and fabrics.

If a fracture match is not possible or applicable, the items may be compared using physical characteristics such as size, color, construction, dimensions, etc. For tape specifically, physical characteristics to be considered include backing properties, adhesive properties, scrim/yarn count (1 inch X 1 inch, if possible), warp and weft fibers, etc. All of the physical characteristics that were used for the comparison must be well documented as part of the case file.

If further analysis is deemed necessary, refer to other applicable Microanalysis Standard Operating Procedures for instrumental operations.

4.4.2 Physical Analysis:

If an item is not applicable for a physical comparison, physical properties such as size, color, texture, construction, etc. will be documented. Other identifying features will be documented as well. Any identifiers such as partial numbers or letters will be searched online for additional information.

5. Measurement Traceability

Any measurement that is made is used only in comparison and is not critical to the results.

6. Reports

The following are possible results concluded from the examination:

Comparison of the evidence submitted revealed matching characteristics along the fracture line(s) to conclude that the evidence had been joined at one time.

Comparison of the evidence submitted did not reveal matching characteristics along the fracture lines.

Comparison of the evidence submitted revealed them to be consistent with respect to (morphology, texture, color, or other physical characteristics).

TENNESSEE BUREAU OF INVESTIGATION
Forensic Services Division

Microanalysis Standard Operating Procedures Manual
Physical Analysis and Comparison



Comparison of the evidence submitted revealed them to be inconsistent with respect to (morphology, texture, color, or other physical characteristics).

Analysis and/or comparison of the evidence submitted was inconclusive.

The exact wording of the results may vary depending on the particular nature of the case.