

**TENNESSEE BUREAU OF INVESTIGATION**  
*Forensic Services Division*

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Microanalysis Standard Operating Procedures Manual  
Physical Comparisons

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## 8.0 Physical Comparisons

- 8.1 Scope - The purpose of a physical comparison is to associate/disassociate two or more items using individual characteristics (fracture matches) or class characteristics (e.g. size, construction, physical properties).
- 8.2 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.  
Hackle marks – fine ridges on a fracture surface.
- 8.3 References  
Standard Guide for Physical Match of Paper Cuts, Tears and Perforations in Forensic Document Examinations ASTM E 2288-03  
  
Bradley, Keagy, Preston etc. “A Validation Study for Duct Tape End Matches” Journal of Forensic Science May 2006, Vol. 51, No.3  
  
Miller, Jerry and H. Kong, “Metal Fractures: Matching and Non-matching Patterns, ATFE Journal, vol. 38(2), Spring 2006, pp. 133-165.  
  
Richard Saferstein Criminalistics 6th Edition Prentice Hall 1998.
- 8.4 Examination Procedures -
- 8.4.1 Evidence Types – This includes, but is not limited to: automobile parts, head lamps, paper, matches, glass, fabric and cordage, buttons, items of clothing, tapes, fabric impressions and any other non footwear or tire impressions.
- 8.4.2 Procedural and Chemical Precautions – See Section 6.0 of this manual for all safety precautions.
- 8.4.3 Limitations – A fracture match may not be possible, among like items, if all the pieces are not submitted.
- 8.4.4 Procedure –

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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. Hard substances often break leaving unique features. Some physical end matches have a three dimensional fit which is helpful in making a conclusive determination. Matching hackle marks and defects should also be examined to reinforce the physical fit. The topography of the two pieces is often mirror images of each other.

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.

If a test impression is necessary, follow the basic outline for acquiring test impressions in SOP 19.0, 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 (size, color, construction, dimensions, etc.). All ways that were used for this comparison must be well documented as part of the case file.

If necessary, instrumentation (previously validated) and microscopy can be used. All generated spectra will be part of the case file record. If an instrument is deemed necessary the examiner must have the appropriate training to show competency.

Final interpretation of the physical comparison analysis will be based on results of the fracture match and/or physical, microscopic and instrumental results.

## 8.5 Instruments and Equipment

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1. Stereomicroscope
2. Caliper
3. Magnifying glass
4. Photographic equipment and accessories.
5. FTIR/ATR
6. Fingerprint powder and brush
7. Adhesive acetate paper
8. Non-adhesive acetate paper
9. Ruler
10. Biofoam
11. Computer system with printer
12. SEM/EDS
13. XRD

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

8.7 Reference Materials –

1. Standard Strontium Nitrate
2. NIST Certified Polystyrene

8.8 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. (This may be followed by other analysis results to associate the evidence i.e. paint comparison, materials comparison, etc.)

Comparison of the evidence submitted revealed them to be consistent with respect to (morphology, texture, color, organic composition, etc.).

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Comparison of the evidence submitted revealed them to be inconsistent with respect to (morphology, texture, color, organic composition, etc.).

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