10.21 Tape Analysis

Analysis may involve a comparison of a questioned tape/adhesive sample to a known tape/adhesive source. Adhesive may be received as a part of a pressure sensitive tape or as an independent sample of adhesive. The request may also be to provide information regarding the manufacturer or end use of a tape/adhesive.

Note: If a tape sample contains fiber reinforcement, the case will be assigned to a fiber examiner.

10.21.1 Analytical Approach

Macroscopic examination of the tape/adhesive evidence keeping in mind the potential for the presence of other evidence (e.g. fibers, hairs, fingerprints). If appropriate, a fracture match comparison can be conducted.

Tapes/adhesives can be characterized by a number of physical and chemical properties.

The size and condition of the evidence may affect the ability to compare all properties. If necessary, the examiner may attempt to detach tape that is folded onto itself by using heat from a heat gun/hair dryer, liquid nitrogen, a “Dust-Off”-type product or solvents such as hexane, methanol, or another appropriate solvent.

During a macroscopic and microscopic examination, note any physical properties which assist in characterizing the tape/adhesive. The adhesive and/or each component of the tape can be further compared with instrumental analysis including fluorescence microscopy, Fourier Transform Infrared Spectrometry (FTIR) and XRF or SEM/EDS. If any unexplainable differences are found during the comparisons, the tapes or adhesives will be determined to be dissimilar.

10.21.2 Macroscopic/Microscopic Examination of Tapes

Purpose: to examine submitted tape evidence on a macroscopic and microscopic scale, noting physical properties, generally as the first step in the characterization and comparison of known and questioned tape samples.

Minimum Standards and Controls: Clean tools and work areas.

10.21.2.1 Analytical Procedures

The sample is examined visually and with a stereomicroscope and the physical properties of each tape sample are noted and recorded. Note the following physical properties, if applicable:

- width of tape in inches and millimeters

- color of backing
- color of adhesive
- texture of the backing
- thickness of the backing and adhesive in inches. (Overall thickness and thickness of backing alone.)
- any machine or calendaring marks on the backing (Viewed with the polarized light attachment on the stereo microscope)

If fiber reinforcement is present, note at a minimum the following physical properties, if applicable:

- weave pattern
- number of machine (warp) yarns per inch
- number of fill (weft) yarns per inch

The physical, chemical, and optical properties of the fibers will be compared and documented in accordance with the procedures for fiber examinations.

Transparent tape backings can be visualized between crossed polarizing sheets when comparing questioned vs. known. Record observations.

If the known and questioned cannot be eliminated, view the backing between crossed polars using the polarized comparison light microscope. Record observations.

The adhesive may be isotropic and, therefore, may not need to be removed.

Tape may be manipulated with forceps and may be dissected using a fine scalpel blade to allow the examiner to thoroughly characterize the physical properties.

An appropriate solvent may be used to separate the adhesive from the backing or fiber reinforcement (e.g. hexane for duct tape, methanol for black electrical tape).

Following removal of the adhesive, duct tapes can be cross-sectioned to determine layer structure, the known and questioned compared and observations recorded.

10.21.3 Macroscopic/Microscopic Examination of Adhesives

Purpose: To examine submitted adhesive evidence when no associated tape backing is present on a macroscopic and microscopic scale, noting physical properties, generally as the first step in the characterization and comparison of known and questioned adhesive samples.

Minimum Standards and Controls: Clean tools and work areas.

10.21.3.1 Analytical Procedures

The sample is examined visually and with a stereomicroscope and the physical properties of each adhesive sample are noted and recorded. At a minimum note the color and texture of the adhesive material.

If there is adequate sample, determine the solubility of the adhesive material in at least hexane, toluene and methanol.

Examine with a compound microscope and record observations.

10.21.4 Fluorescence

Safety Considerations: Do not look directly into the fluorescence source.

10.21.4.1 Analytical Procedure

Some tape backings and adhesives fluoresce when exposed to different wavelengths of light. Of those tapes and adhesives which fluoresce, the observed color and approximate intensity of emission under different excitation wavelengths are noted. Fluorescence can be caused by dyes, pigments, chemical structures, other additives or impurities.

Tape backings and adhesives may be examined in cross-section view or separately using a fluorescence microscope with the room lights off. Record observations.

Because of environmental conditions that the tape or adhesives could have come into contact with, caution should be taken when eliminating samples based upon fluorescence data alone.

10.21.5 Instrumental Analysis

10.21.5.1 FTIR

Safety Considerations: Do not look directly into the laser source. Insulated gloves and safety glasses shall be worn when filling the FTIR instrument reservoir.

Minimum Standards and Controls: Replicate analyses may be employed to ensure reproducibility or to demonstrate variability within a sample. Also see the FTIR standards and controls.

Analytical Procedures

Remove the adhesive from the backing. Obtain spectra from both sides of the known and questioned tape backings. When more than one layer is indicated by cross-sections and/or ATR, obtain spectra from each layer.

If a layer is too thin to isolate, obtain data for this layer via a composite with an adjacent layer.

Compare the spectra of the known and questioned adhesives/tape adhesives.

10.21.5.2 Color Measurements

The microspectrophotometer (MSP) may be useful for the comparison of known and questioned colored, transparent tape backings after removal of adhesive.

Comparison should be performed by overlaying the known and questioned spectra. Any major or unexplainable discrepancies between the two are reason for elimination.

10.21.5.3 SEM-EDS or XRF

Minimum Standards and Controls: Replicate analyses may be employed to ensure reproducibility or to demonstrate variability within a sample. Also see the SEM-EDS and XRF standards and controls.

Known and questioned tape backings and/or adhesives can be compared by their elemental composition.

Comparison of K and Q samples is made on a qualitative basis.

10.21.6 References

ASTM E3085-17 - Standard Guide for Fourier Transform Infrared Spectroscopy in Forensic Tape Examinations

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