



TE15 Examination of Paint	ATF-LS-TE15 Examination of Paint	Published Online: March 2018
Authority: Technical Leader		
Unofficial Copy; May Not Be Most Current Version		Page: 1 of 6

1. SCOPE

Many different types of crimes may involve situations where paint is transferred from one object to another or where paint is sprayed or applied to an object which is submitted as evidence. In these cases, the forensic paint examiner is commonly asked to compare questioned and known (Q and K) paint samples based on their physical and chemical compositions. In conducting those comparisons, the forensic paint examiner's goal is to assess the significance of any differences observed. The absence of any significant differences between the known and questioned samples suggests that the paints could have had a common source of origin.

The physical, optical and chemical properties of known and/or questioned paints may include: Physical - color, layering, microscopic properties, and surface characteristics. Chemical composition may be determined and compared by microsolubility/microchemical tests, FTIR, SEM/EDS, XRF and PGC-MS.

Besides a Q vs. K comparison, the examiner may also be requested to analyze a questioned paint and attempt to determine the possible source(s) of origin for that sample.

In rare instances, a paint chip may be physically matched to a source. In this case a positive identification of the origin of the chip can be determined (Refer to TE10 Physical Match protocol). Additionally, if a unique layering sequence exists between a known and questioned paint sample it can be determined that "short of intentional duplication of layers, the two paint samples originated from the same source".

II. REFERENCES

1. FT-Infrared Spectroscopy of Automobile Paints using Infrared Microscopy", Stoecklein, W. and Gloger, M., *Nicolet FT- IR Spectral Lines*, Spring- Summer 1988, pp. 2-6
2. "Forensic Applications of IR Microscopy", Compton, S. and Powell, J., *American Laboratory*, Nov 1991, pp. 41- 51
3. "The Analysis of Automotive Paints by Pyrolysis Gas Chromatography", Levy. E.J., *Analytical Pyrolysis*, 1977, pp. 319- 335
4. "Pyrolysis- Gas Chromatographic Examination of Paints", Cardosi, P.J., *Journal of Forensic Science*, Vol 27(3), 1982, pp. 695- 707
5. SWGMAT Paint Guidelines
6. "Analysis Protocol for Discrimination of Automotive Paints by SEM- EDXA Using Beam Alignment by Current Centering", Beam, T.L. and Willis, W.V., *Journal of Forensic Science*, Vol 35(5), 1990, pp. 1055- 1063



TE15 Examination of Paint	ATF-LS-TE15 Examination of Paint	Published Online: March 2018
Authority: Technical Leader		
Unofficial Copy; May Not Be Most Current Version		Page: 2 of 6

7. "Application of the LeRosen Test to Paint Analysis", Linde, H.G. and Stone, R.P., *Journal of Forensic Sciences*, Vol 24(3), 1979, pp. 650-655.
8. "Solubility Characterization of Automotive Paints", Thornton, J.I., Kraus, S., Lerner, B. and Kahane, D., *Journal of Forensic Sciences*, Vol 28(4), 1983, pp. 1004-1007.
9. "Evaluation of Automobile Pant Flakes as Evidence", Gothard, J. A., *Journal of Forensic Sciences*, Vol. 21(23). 1976. pp. 636-641
10. Polarized Light Microscopy, McCrone, McCrone, and Delly, Research Institute, 2001
11. Thornton, John I., "Forensic Paint Examination", Forensic Science Handbook, Volume 1, Prentice-Hall, Inc., 1982, pages 529-567.
12. Ryland, S. G. Infrared Microspectroscopy of forensic paint evidence. In: *Practical Guide to Infrared Microspectroscopy*. Humecki, H. (ed.). Marcel Dekker, New York, 1995, pp 163-243.
13. Wampler, Thomas J. (ed.), *Applied Pyrolysis Handbook*, Marcek Dekker, Inc., 1995

Validation

The techniques described below for paint examination are well known and scientifically accepted in the forensic science community and in private industry. Relevant examples of related literature can be found in Section II (References).

III. SAFETY CONSIDERATIONS

- The examiner should follow all the biohazard procedures and use universal safety precautions.
- Precautions need to be taken whenever working with chemicals which could pose potential health hazards.
- Precautions need to be taken when using sharp objects.

IV. APPARATUS/REAGENTS

1. Scraping utensils
2. Forceps, probes, scalpels, razor blades
3. Clean butcher or Kraft paper
4. Stereomicroscope
5. Evidence containers
6. Biohazard safety equipment (if necessary)
7. Vacuum and vacuum filters
8. Spot plates/microscope slides
9. Temporary or permanent mounting media
10. Polarized light microscope
11. Microtome and embedding medium
12. Solvents/microchemical test reagents.
13. FTIR



TE15 Examination of Paint	ATF-LS-TE15 Examination of Paint	Published Online: March 2018
Authority: Technical Leader		
Unofficial Copy; May Not Be Most Current Version		Page: 3 of 6

14. SEM/EDS
15. XRF
16. Pyrolysis GC and/or PGC-MS
17. Microspectrophotometry
18. Miscellaneous analytical instrumentation

V. PROCEDURES

A. PAINT RECOVERY TECHNIQUES

Purpose:

To collect questioned paint samples from items of evidence.

Minimum Standards and Controls:

1. When the paint is recovered by scraping or vacuuming, or the paint fragments are in debris, the examiner must clean the examination area and change the examination paper (using separate examination rooms if possible) between victim and suspect or scene exhibits. The examiner will change the paper between items from the victim and the suspect or more often when appropriate.
2. The examiner must clean their tools between examining the evidence from the victim and the evidence from the suspect.
3. The examiner should follow all the biohazard procedures and use universal safety precautions.

Sampling/Sample Selection:

Some items may have too many paint chips or smears present on them to collect all paint present. Care should be taken to select a representative sample of each visually different paint type for further analysis.

Analytical Procedures for Recovery of Questioned Paint Samples:

1. Thoroughly clean the examination area and cover the worktable with new paper prior to conducting examinations between questioned and known items.
2. Remove the item of evidence from its packaging being sure to collect any loose paint chips that may be left in the packaging container.
3. Conduct a thorough inspection of the questioned item for any paint particles/deposits. Paint samples collected from different areas should be packaged separately and labeled appropriately. If possible, representative paint samples should be isolated using forceps and/or needles.



TE15 Examination of Paint	ATF-LS-TE15 Examination of Paint	Published Online: March 2018
Authority: Technical Leader		
Unofficial Copy; May Not Be Most Current Version		Page: 4 of 6

4. Garments and cloth items may be scraped or vacuumed to dislodge any adhering paint fragments. Scraping is done by holding or suspending the item over a clean sheet of paper and scraping the evidence thoroughly using a clean spatula. If vacuuming is used then separate filters should be used for different areas. Any recovered debris is collected in an evidence container for further analysis.
5. As necessary, the evidence should be sketched, photographed or otherwise documented to note the locations of any tears, paint deposits/smears or other unusual feature(s)

B. STEREOMICROSCOPE/PLM EXAMINATION ANALYSIS

Purpose:

To examine submitted paint evidence on a macroscopic and microscopic scale noting physical properties to assist in comparing known and questioned paint samples

Minimum Standards and Controls:

1. All tools and work areas must be cleaned prior to beginning work and between samples from different locations.

Analytical Procedures for Stereomicroscopy/PLM Examination of Paint:

1. The sample is placed under the stereomicroscope and examined. The physical properties of each paint sample are noted and recorded on a worksheet or written notes. The layer sequence, color, texture, relative thickness of the layers and any unusual features should be noted.
2. If multiple layers are suspected, a thin peel, cross section, or bevel cut should be prepared to visualize the layers. If a cross section is made, it may be hand sectioned or mounted in an appropriate mounting media and sectioned using a microtome for subsequent analysis. The layer sequence, color, texture, thickness of the layers, pigment morphology, and any unusual features should be noted. If possible, pigment types should be identified. Comparison of the layers may require a comparison microscope.
3. If any significant differences are observed between the known and questioned samples, the samples are dissimilar.

Sampling/Sample Selection:

If a number of questioned paint chips are recovered, they shall be examined using the stereomicroscope and/or polarizing light microscope. If it is concluded that all the questioned paints are consistent in appearance (color, layering, microscopic characteristics) to one another, then they can be considered a homogeneous group and additional analysis (e.g. Microchemical tests, FTIR, SEM/EDS, MSP, PyGC-MS) can then be performed on a select few of the questioned paints. In these instances, results of the additional examinations can be used to represent the group of microscopically consistent paints as a whole.



TE15 Examination of Paint	ATF-LS-TE15 Examination of Paint	Published Online: March 2018
Authority: Technical Leader		
Unofficial Copy; May Not Be Most Current Version		Page: 5 of 6

C. SOLVENT/MICROCHEMICAL TESTS

Purpose:

To determine the solubility and chemical reactivity of individual paint layers in known and questioned samples.

Minimum Standards and Controls:

1. Solvents and chemical reagents are prepared and documented according to generally accepted recipes. Chemicals should be checked on known samples or in some manner that assures they are working properly and these checks should be documented in the case record.

Analytical Procedures:

1. Place the paint sample on a microscope slide or spot plate.
2. While observing the sample, apply the reagent or solvent to come into contact with the particle. Any resulting reaction should be recorded. Note the effect of each reagent on the individual paint layers for the questioned and known paints. Use of a stereomicroscope will aid in the observation of any reaction.
3. The samples are dissimilar if any significant differences are observed between the questioned and known paints.

D. INSTRUMENTAL ANALYSIS

Purpose:

Other analytical instruments that may be employed to characterize organic and inorganic constituents are listed above (Section IV. Apparatus/Reagents). These techniques are used to further discriminate between paints, as well as to provide classification and source assessment.

Minimum Standards and Controls:

1. Reference data of known paints, pigments, and polymers from the instruments employed is desirable.

Analytical Procedures:

1. Appropriate sample preparation and analytical parameters should be used for each instrument used (see protocols for each instrument).
2. When comparing paint samples, the same analytical techniques (i.e.: FTIR) should be performed in the same manner (i.e.: thin peel of each layer placed on a KBr pellet for analysis) on both the known and questioned paints.
3. During the paint examination scheme, if any significant differences are detected between the



TE15 Examination of Paint	ATF-LS-TE15 Examination of Paint	Published Online: March 2018
Authority: Technical Leader		
Unofficial Copy; May Not Be Most Current Version		Page: 6 of 6

questioned and known paint, a conclusion can be made that the paints do not have a mutual origin.

4. Generally, when sample size is limited, destructive testing is performed after all non-destructive testing is complete.
5. Compare the generated spectra/chromatograms of the known and questioned samples and evaluate the data.
6. It should be noted that due to the condition, size and/or type of paint, analysis using some of the aforementioned instrumentation may not be appropriate or possible.

VI. QUALITY ASSURANCE/ QUALITY CONTROLS

Through proper training, competency testing, and proficiency testing of paint examiners as well as through the use of high quality equipment which is appropriately cleaned, maintained, and quality checked (e.g. calibrated, performance checked) the quality of this method is assured.

Because paints are mass produced, short of a physical match or unique layering structure, a questioned paint cannot be positively identified back to a specific source; therefore, the use of error rates is not applicable.