# An Interesting And Microscopic Study Of Fracture Marks On Broken Plastic Automobile Indicator Lamp Coverings

P Ramakrishnan

**Citation**

P Ramakrishnan. *An Interesting And Microscopic Study Of Fracture Marks On Broken Plastic Automobile Indicator Lamp Coverings*. The Internet Journal of Forensic Science. 2006 Volume 2 Number 2.

**Abstract**

In most of the hit and run cases the comparison of paints adhered to the vehicles involved, glass, tyre marks and soil cakes beneath the vehicles played an important role in crime investigation. In addition to the above, the broken parts of the vehicle including the indicator lamp coverings form important evidence in forensic examination. The literature survey revealed that most of the work was carried out in the area of automobile plastics are related to the trace element composition of material, abnormalities in physical properties, product defects and the effects of heat on plastic material. Apart from the usual mechanical fit of the broken plastic indicator lamp coverings, an interesting microscopic characteristic features of fracture marks which are peculiar in nature and similar to the radial marks as seen in the glass were observed on the cross-section. The present paper envisages these interesting observations on the cross-section of broken plastic indicator lamp coverings such as radial type marks, straight-line marks and concentric marks. These striations/marks enable to identify and match the broken parts of the plastic lamp coverings. The study of these fracture marks under stereo and comparison microscope can be utilized in giving the positive opinion on comparison of broken plastic parts during their routine physical examinations.

## INTRODUCTION

In most of the hit and run cases, comparison of the physical evidence left at the scene of crime such as paints, glass, tyre marks, plastics, soil cakes etc. form an prime importance as evidence material for forensic science providers ([1]). In present scenario plastics are finding its important role in day-to-day life and various other applications. Especially in modern day vehicles, various kinds of plastics are playing major role and replacing the usage of metal in the form of different automobile parts. As a result, plastics in the form of broken automobile trim, indicator lamp coverings and headlamp domes etc. of the two and four wheelers at the scene of accident as well as from the seized vehicles wheelers are being frequently encountered as physical evidence. Such broken plastic materials are sent to laboratory for comparison and for giving the opinion as well as helping the investigating officer in solving the crimes. The ability to compare and ultimately identify and opine on the plastic material from scene of crime with similar items in the possession of suspects is of prime importance for the forensic scientist.

In this paper, the author presented the unusual and interesting microscopic characteristics of fracture marks and their peculiar features that would enable to identify and match the two broken plastic pieces. For the study of these features and characteristics, the plastic indicator lamp coverings of two and four wheelers have been taken and studied for comparison and matching. The studies on the surface characteristics defects, trace element analysis, effect of heat and fatigue fractures in plastic material have been studied elsewhere ([3],[5]).

## MATERIAL AND METHODS

For the present study the plastic indicator lamp coverings of the two wheelers such as bikes and scooters and four wheelers have been chosen. Broken side indicator lamps and tail lamps of commonly available colours that is orange-yellow and red have been taken for the study. The physical measurements such as thickness, size and pattern design on the surface of these lamp coverings of both the two and four wheeler vehicles have been taken for data collection and record, which could be used for further study later in this area. Both the tail plastic lamp cover and side indicator plastic lamp cover were taken for microscopic study of its broken cross section. Henceforth both the tail lamp and side plastic indicator lamp coverings will be called as ‘lamp coverings' throughout the description in this paper.

The lamp coverings were separately broken manually and

also by applying a small pressure to it by fixing them between the vices. The cross-section of broken lamp coverings was observed under the stereomicroscope at a magnification of 4x/25x and Leica comparison microscope at the magnification of 32 x objective and 2.5x eyepiece. For entire study of the pattern analysis on the cross-section of the lamp coverings the leica image processing comparison microscope has been utilized exhaustively. Lighting conditions are found to be very important since the material being semi-transparent, oblique lighting at various angles using the trail and error method had been used for optimum microscopic observation of the peculiar characteristic on the cross section. Entire study has been photographed and stored in the image processing software of the comparison microscope.

## RESULTS AND DISCUSSION

Comparison microscopic observations of lamp covering are given in the figure 1 to figure 19. The complete study of lamp coverings of two and four wheeler including the orange-yellow and red colour plastic coverings is based on various microscopic characteristic observations. The figures presented are depicting only some of the important features observed under the microscope, which are of forensic importance and relevance. The figure 1 and figure 2 shows the general top and bottom microscopic view of the broken lamp coverings. The surface characteristics such as the design pattern, manufacturing defects, colour and striation on surfaces are studied separately and presented elsewhere ([4,6]). The figure 3 and figure 4 shows the scratch marks, striations and design pattern on both the surfaces of the lamp coverings. The figure 5, figure 6, figure 7 and figure 8 are showing the characteristic brittle fracture marks, radial type marks, hackle marks and rib type marks similar to that seen in glass([2]) are observed at the various oblique lighting condition. Figure 9 shows the side-by-side matching characteristics of the cross-section of the broken lamp coverings. The figure 10 shows the matching of the peculiar characteristic marks of the plastics observed under the comparison microscope at the magnification of 25x/32x.

At a glance, it appears as a finger print patterns. Upon thorough study of these marks on lamp coverings, it appears that final tearing effect of the broken plastic material has taken place at this juncture, which has been observed as minute secondary fractures ([7,8]). The characteristic marks such as striations, rib marks, radial marks and brittle fracture marks shows the force of impact that has been travelled along in the plastic material in a regular and unique pattern of design. These rib marks as observed are perpendicular on the opposite surface and tangential on to the loading surface. Hackle type marks apparently are to be found and observed at the right angle to the rib type of marks. The repeatability and re-occurrence of these marks are found to be different under various force of impact and angle of impact([8]) but all the uniqueness and peculiar characteristics could be determined in all the cases of broken parts, which have been studied.

The type of the material used i.e. kind of plastic also plays an important role in the formation of these unusual and peculiar characteristic features. These type of marks were also observed in the plastics materials such as spectacle legs/frames, toothbrushes, broken buttons, plastic combs etc. The fracture energy and impact angle have not been taken for the study but kept the note of it for later detailed analysis.

## CONCLUSION

Apart from the routine mechanical fit of the broken parts of plastic indicator lamp coverings, these additional microscopic features of fracture marks and their characteristics on the cross-section of such plastic material will give an additional important parameter in giving the positive opinion during the comparison of broken plastic pieces. Further it also open up a new area for the additional study of direction of break and impact of forces by detailed and in-depth study of the characteristic marks seen on the cross section of plastic material. Due to their (plastic materials) uniqueness in its material composition and also involving different manufacturing techniques in the production of different kinds of plastics for various applications, such a study will definitely be useful for analyzing and giving a opinion when these plastics materials are encountered in crime examination.

## ACKNOWLEDGEMENT

Author wishes his sincere thanks to Shri M Varaprasad, Senior Scientific Assistant(Physics) for his photographic assistance and Miss. M Maheswari, Scientific Assistant (Physics) for the assistance in analysis and also to Dr. S. K. Shukla, Director, Central Forensic Science Laboratory, Hyderabad for his constant encouragement and valuable guidance throughout the study.

### References

1. Kirk, P.L., Crime Investigation, Interscience, New York, 2nd Edition, 1966, 232.

2. Haward, R.N., The Behaviour of Glass under Impact and Static Loading, Journal of Society Glass Technology, 1944 (1), 28.
3. Pierce, D.S., Identifiable Markings On Plastic, Journal of Forensic Identification, 1990, 40(2), 51-59.
4. Cleverly, B., The Comparison and Matching of Low Density Polyethene Bags by IR Spectroscopy, Journal of Forensic Sciences, 1979, 24, 339-345.
5. A S Athalye, Identification and Testing of Plastics, 1995.
6. Denton, S., Extrusion Marks on Polyethene Films, Journal of Forensic Science Society, 1981, 21, 259-262.
7. F.R. Larson and F.L. Carr, How Failures Occur-Topography of Fracture Surfaces, Source Book Of Failure Analysis, American Society for Metals, Metals Park, OH, 1974.
8. M. Ezrin, Platic Failure Guide: Cause and Prevention, Hanser Publishers, New York, 1996.

## Author Information

**P. N. Ramakrishnan, M.Sc. (Applied Physics)**
Scientific Officer (Physics Division), Central Forensic Science Laboratory, Directorate of Forensic Science, Ministry of Home Affairs, Government of India