

1949

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Roger S. Greene

David Q. Burd

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Recommended Citation

Roger S. Greene, David Q. Burd, Headlight Glass as Evidence, 40 J. Crim. L. & Criminology 85 (1949-1950)

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HEADLIGHT GLASS AS EVIDENCE

Roger S. Greene and David Q. Burd

The authors, Roger S. Greene and David Q. Burd, are members of the staff of the Technical Laboratory, Division of Criminal Identification, California State Department of Justice, and graduates of the University of California. Both writers are known to our readers through their previous scientific contributions. This article continues the series of studies of the physical properties of glass as a means of identification of fragments, which has been made by a group of research workers during the last several years. The need for this excellent research study was brought about by the demands of criminal investigations—EDITOR.

Fragments of glass have for many years proven to be of importance in criminal investigations. This is especially true in the case of glass from automobile headlight lenses which are broken at the scene of hit and run accidents. In these cases, the law enforcement laboratory is often called upon to determine whether or not fragments recovered at the accident scene are identical with particles of glass found in damaged headlights on suspected vehicles. The comparisons may be relatively simple, and the results conclusive if a physical match can be made of broken edges of glass from the two sources. In other instances, where a direct physical match is poor or cannot be found at all, the mold markings or minute scratches on glass fragments can be compared by using strong oblique illumination. Most frequently, however, the fragments from at least one of the two sources are very small or necessary connecting pieces are not recovered from either the accident scene or the suspected vehicle. When this occurs the comparison of the exhibits must depend upon physical or chemical methods, and it becomes the task of the laboratory worker to determine the evidence value of the results obtained.

A number of surveys have been made of glass comparison methods. These included general studies, such as those made by Tryhorn (1) and many others. More recently, papers have been published in this Journal on comparative studies of physical properties of glass fragments. The first of these by Gamble, Burd and Kirk (2) covered a study of the refractive index and specific gravity of one hundred miscellaneous glass fragments from a wide variety of sources. In this investigation, it was possible to distinguish each of the samples from all others examined on the basis of refractive index and specific gravity. More recently, Kirk and Roche (3) compared fifty samples of brown bottle glass by these same methods. This study showed that all but two of the bottle glass samples considered could be distinguished from each other by refractive index and specific

gravity. The present work was carried out to determine whether or not the results would be similar when samples of glass which are believed to be subject to more accurate quality control are compared. Because the authors frequently have been called upon to testify in the courts concerning headlight lens glass comparisons, it was desired to obtain at least an approximate figure as to the proportion of such glass samples that would have indistinguishable differences in composition.

GLASS SAMPLES STUDIED

Fifty automobile headlight lenses were obtained from a collection belonging to the California Highway Patrol. These were of numerous designs manufactured over a period of several years by the same glass company, although sold under various trade names. Small pieces weighing between $\frac{1}{2}$ and 2 grams were broken from these lenses, and each was assigned a number which was placed on the specimen with a tungsten carbide tipped scribe. Where necessary, for microscopic study, much smaller particles were broken from these larger specimens, although all of the basic work was carried out on the large pieces.

EXPERIMENTAL—SPECIFIC GRAVITY

In an attempt to determine the exact specific gravity of the samples each was weighed in air and in water on an analytical balance, a wetting agent being used in an attempt to control surface tension. This method was found to be very unsatisfactory for even a rough separation of the specimens studied and certainly would not be suitable for use with the very small fragments of glass usually encountered in law enforcement work. In spite of very careful weighing and the comparatively large size of samples used, many of the specific gravity figures were later found to be inaccurate. For this reason, all further determinations were made by a method similar to that used by Kirk and Roche (2) which gives comparative values of density only. This consisted of first placing all specimens in a container sufficiently large to hold them without serious interference. Enough bromobenzene was used to completely submerge them, and bromoform was then added in small increments with adequate stirring. As the bromoform was added the specimens floated in their approximate order of density, beginning with those of lowest specific gravity. By this method, the fifty samples were segregated into twenty-six groups having readily distinguishable differences in density. Each group contained from one to four specimens.

To complete the specific gravity separations, the samples in each group of unseparated specimens resulting from the work just described, together with those of the groups of next higher and next lower density, were carefully compared by a more precise technique. This consisted of adding the bromoform more slowly, using a smaller container and keeping the container covered at all times to reduce differential evaporation, which tends to produce disturbing currents in the liquid. Each sample was first cleaned, washed in the liquid used and examined carefully to make certain that no dust particles or minute air bubbles adhered to the glass since these would naturally alter the apparent specific gravity of the specimens. No temperature control was used in this phase of the work because only comparative and not absolute specific gravities were being measured. Handling of the container was reduced to a minimum to prevent uneven warming and consequent production of disturbing convection currents. By this more precise method, most of the groups were further broken down. The fifty specimens were finally divided into forty-one groups; thirty-three of the groups containing just one glass specimen, seven containing two specimens and one containing three specimens.

A further attempt to refine this method was made by controlling the temperature of the balancing liquid. For this purpose a precision type constant temperature bath which maintained any set temperature within $\pm 0.03^{\circ}\text{C}$. was used. Specimens which could not be separated by the previous comparisons were immersed and balanced by adding small amounts of the proper liquids, the final adjustment being completed by appropriately raising or lowering the temperature. By this method, it was still not possible to complete the separation in all of the remaining groups of two or three samples.

It seemed desirable to estimate the ability of this technique to distinguish between glasses of closely similar specific gravity. To do this it was assumed that the coefficient of the cubic expansion of the immersion liquid did not exceed 0.002 per degree Centigrade, and the temperature bath varied no more than 0.06°C . This would result in specific gravity variations of not more than 0.00012 (0.002×0.06). The immersion liquid and suspended glass are normally in slow but perceptible motion as a result of the small temperature variations. We therefore conclude that the procedure used is not capable of distinguishing between glasses differing in specific gravity by less than approximately 0.0001.

Since all results so far obtained were strictly relative, with

the exception of the figures originally found by the unsatisfactory water displacement method, the specific gravities of the lowest and highest specimens were accurately measured. This was done by balancing them in a 25 ml. pycnometer at 20°C. and making appropriate weighings, at least two separate determinations being made. The lowest specific gravity was found to be 2.4658 and the highest 2.4790. Thus the fifty samples studied were distributed between these two extremes, a range of 0.0132.

EXPERIMENTAL—REFRACTIVE INDEX

The refractive indices of the fifty specimens were determined by direct measurement on a refractometer accurate to ± 0.0001 . This separated them into twenty groups, each containing from one to seven specimens. It must be pointed out, however, that this separation was not absolute as between adjacent groups due to inherent limitations in the method and instrument used. To make these measurements on the refractometer, two surfaces on each piece of glass were ground to form approximately a right angle and one of these surfaces was polished to produce a substantial area not differing from optical flatness by more than two fringes. Each refractive index measurement was made at least twice by two individuals and, therefore, the results are believed to be accurate within the limits indicated. The lowest figure obtained was 1.5072 and the highest 1.5101. Thus the fifty specimens were distributed between these two extremes, a range of 0.0029.

Further separations of various specimens found to have the same refractive index on the refractometer were attempted by the microscopic immersion method using stable liquids and a monochromatic light source. These studies failed to make any significant further separation, and for this reason they were not completed and considered in tabulating the final results.

While measurements on the refractometer were being made the dispersion readings were noted for each specimen. All of these readings were found to be identical, and it was concluded that dispersion comparisons of headlight lens glass are of no value when done by this method.

It is interesting to note that a graph showing the distribution of the specimens examined with respect to refractive index approximated a normal frequency distribution curve. This indicates the consistent quality control by the manufacturer of these particular lenses over a period of a number of years. No such graph with respect to specific gravity could be made from

our data since the exact figures were not determined for this physical property.

RESULTS

Study of the experimental results disclosed that with the exception of two specimens the glass in all of those groups containing more than one sample having the same specific gravity were of sufficiently different refractive index to be readily distinguished. It was not possible to distinguish those two by refinements of either of the methods used. The findings, therefore, exactly corresponded with those of Kirk and Roche previously mentioned.

ADDITIONAL STUDIES

A number of research studies remain to be undertaken to fully explore the value of glass fragments as evidence. Among these are the following:

1. Comparison of a large group of sealed beam headlight lenses of the same manufacturer which were made at approximately the same time by methods similar to those described in this article.

2. Spectrographic comparison of the same group of lenses compared in the present study or some other comparable group of samples.

3. Determination of the order of accuracy of specific gravity comparisons by studying the effect of such factors as immersion liquid viscosity, particle size and shape, and temperature regulation.

4. Further research on the normal variations in specific gravity in various parts of single glass articles. This should include attempts to correlate visible internal striations with the observed specific gravity range in each piece of glass.

5. Exploration of the possibilities of using the phase microscope to increase the accuracy of refractive index measurements made by immersion methods.

REFERENCES

1. Tryhorn, F. G., *The Examination of Glass*, J. Crim. Law & Crim. (Pol. Sci. Sec.), 30, 413 (1939)
2. Gamble, L., Burd, D. Q., and Kirk, P. L., *Glass Fragments as Evidence*, J. Crim. Law & Crim. (Pol. Sci. Sec.) 33, 416 (1943)
3. Kirk, P. L. and Roche, G. W., *Differentiation of Similar Glass Fragments by Physical Properties*, J. Crim. Law & Crim. (Pol. Sci. Sec.) 33, 168 (1947)