TECHNICAL NOTE

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The Breaking of Tempered Glass Vehicle Windows Using Broken Spark Plug Insulators

REFERENCE: Springer, E. and Zeichner, A., "**The Breaking of Tempered Glass Vehicle Windows Using Broken Spark Plug Insulators,**" *Journal of Forensic Sciences*, JFSCA, Vol. 31, No. 2, April 1986, pp. 691-694.

ABSTRACT: A novel and efficient method for forced entry into vehicles using broken spark plug insulators to break the windows was reviewed. Various experiments were performed in which a number of objects, varying in their physical characteristics, were compared to the broken ceramic plus insulators in order to examine the uniqueness of the latter in the breaking of tempered glass. A plausible mechanism was presented attributing the great efficiency of the insulators to their hardness in relation to other materials (MOHS scale), and to their potential for the concentration of force in one point because of the sharp, jagged ends.

KEYWORDS: criminalistics, glass, breaking

Through the course of our contact with the various field units of the Israel police force, we received reports of a new, simple, and efficient method of forced entry into vehicles. The method was that of taking the ceramic insulator from spark plugs, breaking it into small, jagged pieces, and throwing them at the side window of a parked vehicle. The windows, which are usually made from tempered glass [*1*], would crack easily and almost noiselessly into many small places as is characteristic of glass of this type. All that was left to do was to remove the pieces of glass, thus permitting unobstructed entry into the vehicle.

After increasing numbers of such reports, it was decided to conduct some basic experiments that might lend validity to the claims and help determine a possible explanation for this phenomenon.

Materials and Methods

The tests were carried out on tempered glass plates of 0.5-cm thickness, of the type used in European vehicles. These types were obtained from two manufacturers: Volkswagen and Phoenicia Glass Works of Israel. A wooden frame was built so as to provide support for the glass along its perimeter. A number of objects varying in their physical characteristics were compared to broken ceramic spark plug insulators of various weights, in order to examine the uniqueness of the latter in the breaking of tempered glass plates. Two different methods were

Received for publication 20 May 1985; accepted for publication 19 June 1985.

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used in carrying out the tests. In the first one, the objects were thrown at the glass by the same person using about the same amount of strength—as much as is subjectively possible to estimate.

In the second method, a slingshot was prepared so as to simulate the throwing velocity of an average person and at the same time keep it constant. The average throwing velocities attributed to the throwing of an object and the projection of the slingshot were estimated by measuring the duration of the vertical throwing or projection.

In addition to the above two methods, the effect of a steel-tipped punch employed by using a slight tap from a hammer was examined. Scratch tests were performed to determine the hardness of the objects used in the experiment.

Results and Discussion

The results of the tests are summarized in Table 1. The objects used in the tests appear in Figs. 1 to 3.

As is apparent from the results, the pieces of spark plug insulator are much more efficient in breaking the glass than the other, common materials that were tested (provided that "efficiency" is defined as the results of the throw versus the weight of the object).

Though the minimum weight of a spark plug fragment that was found capable of breaking the tempered glass was 0.06 g, it should be emphasized that in some of the experiments, broken plugs of up to 3 g did not succeed in breaking the glass.

A plausible mechanism for the phenomenon is the following: in the manufacturing of tempered glass, compressive pressures are produced at the surface and tensile stresses in the center [2]. A considerable load must be applied to the glass so that tensile stresses can be developed on its surface, where the crack originates. When a crack penetrates the outer, "compressive skin" into the tension area, the crack can become rapidly self-propagating.

It would therefore be reasonable to assume that the great efficiency of the spark plug insulators in breaking tempered glass results from two of their characteristics:

(1) their hardness in relation to other materials and

(2) their potential for the concentration of force in one point because of their sharp, jagged ends.

This mechanism also explains why relatively "heavy" spark plugs may not be efficient in shattering the glass if either they do not have sharp, jagged ends or these ends do not come into contact with the glass during the impact.

TABLE 1—*Attempted shattering of tempered glass.*

No. of Trial	Object Thrown	Weight of Object, g	Success in Shattering	Hardness (MOHS Scale)
1	spark plug insulator	0.17	+	8.0-8.5
2	metal piece	4.83	−	4
3	screw	2.66	−	4
4	nut	4.69	−	4
5	(silicone carbide ceramic [SiC] in soft matrix)	3.49	−	...
6	ceramic (SiC in soft matrix)	3.97	−	...
7	stone	17.99	−	3
8	punch	...	+	6.5

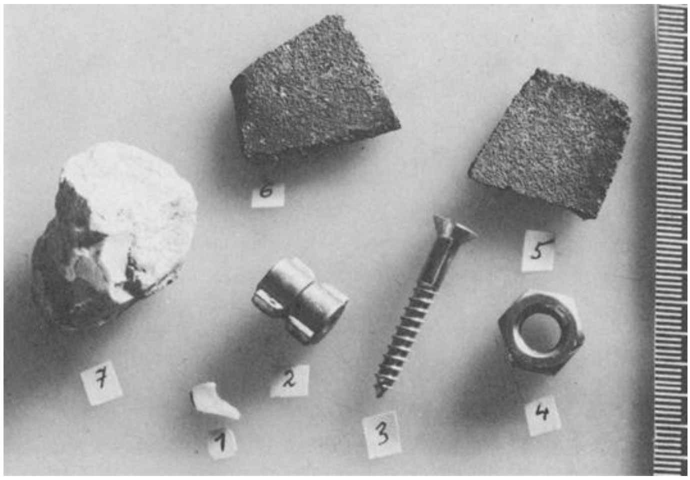

FIG. 1—*Objects thrown at tempered glass plates.*

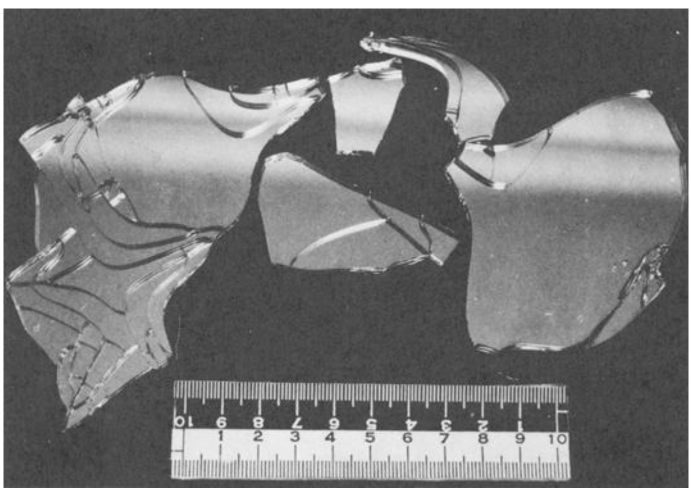

FIG. 2—*Cracked glass from Phoenicia Glass Works of Israel.*

Conclusion

The tests that were performed provide a general understanding as to the relative ease with which spark plug insulators are capable of breaking tempered glass.

The information obtained regarding this novel method of forced entry into vehicles was relayed to the investigation, detective, and intelligence squads of the Israel police force. As a result, during body searches, particular attention was given to broken pieces of spark plug insulators, a once innocent object.

Acknowledgments

The authors would like to express their thanks to Prof. D. Katz of the Technion-Israel Institute of Technology; Drs. J. Almog and S. Kraus of the Criminal Identification Division, Israel

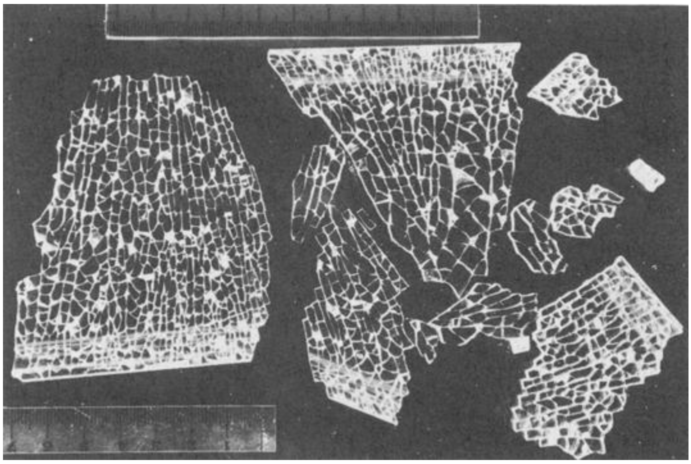

FIG. 3—*Cracked tempered glass from Volkswagen.*

National Police, for helpful discussions; and Dr. M. Springer for assistance in the preparation of this manuscript.

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