B103 The Relationship Between Terminal Velocity and Glass Fracture via .177 Caliber Steel BBs

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Learning Overview: After attending this presentation, attendees will have gained knowledge in the study of low-velocity projectile impacts and the resulting fracture patterns on double-strength architectural glass. Attention will be focused on the Doppler radar system and its measurement of projectile velocity.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing information on the effects of low-energy projectiles on architectural glass, which can be helpful in reconstructing glass fracture patterns at crime scenes.

Glass is an abundant material in the environment and can also be an abundant material found at crime scenes. It may often be the only thing between a bullet and its intended target, which is where fractography becomes necessary. "Fractography is the means and methods for characterization of fractured specimens or components."[1] The majority of bullets will perforate or shatter most categories of glass; however, in some cases, the bullet may not have sufficient energy to shatter the glass at all. Correlating terminal velocity to the degree of glass fracture can provide useful information regarding the muzzle-to-target distance for a particular firearm/ammunition combination.

Mechanical glass fracture from a projectile impact can result in different types of fracture patterns, including radial and concentric fractures. The degree of fracture depends on several factors, including: type of glass, the thickness of the glass, curvature (if any), distance from the muzzle, and type of projectile. This research focuses on the terminal projectile velocity of .177 steel BBs shot from a pneumatic air rifle. Double-strength glass panes, of ⅛" thickness, were chosen due to its common use in commercial and residential properties. A Doppler radar system was used to measure the projectile velocity from muzzle to target and potentially beyond the target for perforated targets.

Other research has been presented on the subject of dynamic impact glass fracture using timekeeping instruments such as traditional chronographs.[2-5] The use of a Doppler radar system has the advantage of coupling Doppler processing with pulse radars to provide accurate velocity information with superior precision.

Pilot studies have been conducted to ascertain suitable muzzle-to-target distance ranges (12 to 20 feet), the number of pumps required to pressurize the air rifle propulsion system (one to three), and the means of measuring the ricochet distance for projectiles that do not perforate the glass substrate. The experimental methodology was developed from the pilot study results.

The goal of this research is to characterize the relationship between impact velocity and glass fracture pattern. The results of this study can be used to develop future experiments using other types of firearms and ammunition to study glass fracture patterns. It is intended that this research will aid in the advancement of glass fracture analysis, which can be useful in crime scene reconstruction.

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Glass Fractography, Doppler Radar, Terminal Velocity

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