Abstract: Bullets passing through windshield glass (safety glass) typically produce oval-shaped holes due to the slant of the windshield. The direction of the shot is determined by examining the margins of the hole. The margins of both sides (entry and exit) will show some degree of concaveness, however the margins of the exit side will be more distinctly and more uniformly concave. When shots are fired through vehicle windshields, bullets frequently fragment. Attempting to equate the trajectory of a shot to the bullet hole in the windshield and the impact point of a fragment is unreliable. While it is certainly true that the trajectory is going to be best represented by the largest fragment (e.g. the bullet core), this is still only going to allow a rough approximation of the true trajectory to be made. As far as the lateral (side to side) trajectory is concerned, a more reliable technique results from using the degree of cant (inclination) of the long axis of the oval hole that is typically produced.

Introduction

U.S. made automobile windshields consist of two sheets of plate glass with a piece of plastic sandwiched in between. This laminate is held together with adhesive. This design prevents injury from sharp “sabers” of glass upon breakage, as in a vehicle accident.

Because of the laminate design, two things occur when a bullet passes through the windshield of an automobile: the glass holds together rather than falling out and the resultant bullet hole has somewhat irregular margins. Depending upon the bullet design, some degree of expansion will be produced upon impact with windshield glass. This produces a hole with a greater width than the bullet caliber. This effect tends to be irreproducible, thereby making width to length based vertical angle determinations unreliable.

The vertical angle of a bullet trajectory through windshield glass, along with other information (i.e. shooter height, weapon position, etc.) allows a determination to be made as to the approximate muzzle to target distance. If a bullet does not fragment, the secondary target impact point may be used to establish an approximate vertical trajectory angle. In numerous test firings conducted during the course of shooting reconstruction classes presented by the author, some downward deflection of hollow point bullets in particular has been observed. If the bullet fragments, using the secondary impact point of even large fragments (i.e. bullet cores) results in only a rough approximation of vertical trajectory. Test firing under circumstances similar to those of the shooting is always recommended as part of the reconstruction effort.

Even when the vertical trajectory angle cannot be reliably determined, all is not lost. The lateral (side to side) angle is frequently a major consideration in shooting reconstructions involving shots fired through windshields, particularly in officer-involved shootings. The question as to justification of use of lethal force is often, erroneously or not, tied to whether or not the lateral trajectory angle of one or more shots puts the officer in front of the vehicle. Being able to reliably predict the lateral trajectory angle can be a crucial aspect of a shooting reconstruction in and of itself.

Lateral angle determination using the long axis of a bullet hole

Due to the slant of an automobile windshield (on the order of 30 degrees), bullets fired straight on produce oval holes. Oval bullet holes in windshields with a more or less vertical long axis are indicative of a shot fired directly in front of the vehicle. When the long axis is canted to the left or the right of vertical, a shot at a corresponding angle to the left or right is indicated. These concepts are summarized below.
Figure 1. Bullet hole produced in a windshield by a shot directly from the vehicle front as indicated by a vertical long axis for the hole.

Figure 2. Bullet hole produced in a windshield by a shot from the side of the vehicle as indicated by an angle to the right of vertical for the long axis.
A method for determining the angle of inclination for the long axis of a bullet hole is illustrated below. The edge of a steel ruler is aligned with the long axis of the bullet hole. A protractor is then aligned with the base parallel to the plane of the front of the vehicle. The resultant angle is then read off the protractor. In this example the angle is 17 degrees to the right (the numbers on the protractor appear reversed since they are imprinted on the inner side). This then equates to a lateral angle of 17 degrees toward the passenger side of the windshield.

Discussion

In numerous test firings conducted by the author during the course of shooting reconstruction classes, the reliability of this technique has been demonstrated. As with any such measurement involved in a shooting reconstruction, this is an approximation and should not be represented as an exact measurement. In the author’s experience results within plus or minus 5 degrees are typical.

In the event that a circular bullet hole is produced in a slanted windshield, the vertical component of the trajectory angle had to be approximately equal to the slant of the windshield. The windshield slant should be determined using an angle gauge placed at the mid-center of the windshield (the area below the inside rear view mirror).
References


