Use of Doppler Radar to Generate Trajectory Solutions

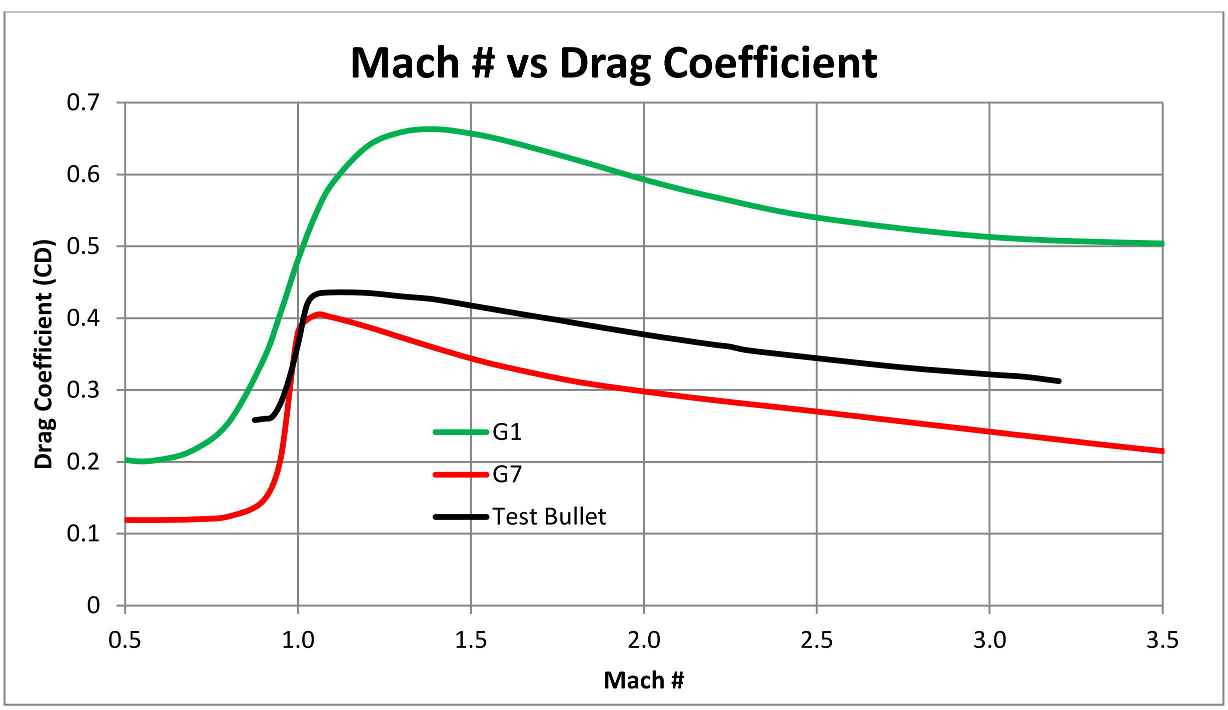
How much confidence should you have in a trajectory table that shows downrange point of impact and velocity/energy values? Before answering that, one should probably understand how that trajectory table was generated.

Typical trajectory tables are generated by measuring only two values; muzzle velocity, and either time-of-flight to a downrange target, or a second downrange velocity. Depending on the test facility where this data is gathered, that downrange target or chronograph may only be 100 to 300 yards from the muzzle. These values are used to calculate the Ballistic Coefficient (BC value) of the bullet, and the BC value is then referenced to a standardized drag curve such as G_1 or G_7 to generate the trajectory table.

This approach works reasonably well for the distances encountered in most hunting and target shooting conditions, but breaks down rapidly for long range work. It's really an archaic approach based on artillery firings conducted in the late 1800's and computational techniques developed before the advent of modern computers.

There is a better approach which has been utilized by modern militaries around the world for many years to generate very precise firing solutions. Due to the sizeable investment required, it has been slow to make its way into the commercial market. This modern approach is to use a Doppler radar system to gather thousands of data points as a bullet flies downrange. This radar data is used to generate a bullet specific drag curve, and then fed into a modern 6 Degree of Freedom (6 DOF – accounts for x, y, and z position along with the bullet's pitch, yaw, and roll rates) to generate precise firing solutions and greatly increase first round hit probability.

Barnes has invested heavily in this modern approach. Our Doppler radar system can track bullets out to 1500 meters, recording the velocity and time of flight of that bullet every few feet along the flight path. Consider the graph below showing a bullet specific drag curve referenced to the more common G_1 and G_7 curves:



Neither of the standard curves is a particularly good match to our test bullet. In the legacy approach to generating a downrange trajectory table, the BC value is in effect a multiplier or a fudge factor that's used to shift the drag curve of the test bullet to try and approximate one of the standard curves. This leads to heated arguments as to which of the standardized drag curves is a better fit, or if multiple BC values should be used to better approximate the standard curve (e.g., use one BC value when the velocity is between Mach 1 and Mach 2, and a different BC value when the velocity is between Mach 2 and Mach 3.)

Barnes' approach to creating trajectory tables is to generate bullet specific drag curves, and use that data directly in a modern, state-of-the-art, 6 DOF ballistics program called Prodas to generate the firing solution. We still use the Doppler radar data to generate and publish BC values for our bullets – the value is useful in comparing one bullet to another, but our new trajectory tables are generated using Prodas.

What does this mean for you? You can have complete confidence in Barnes' trajectory tables. We've invested hundreds of thousands of dollars in state-of-the-art ballistics equipment and software, spent countless man-hours gathering and analyzing the data to give you, the shooter, the ability to make that first shot count.