ELD-X, ELD Match and Heat Shield Frequently Asked Questions

Q: Does velocity make tips melt or is it just a matter of exposure to aerodynamic friction over time?

A: It is a function of the softening point of the plastic, air temperature, bullet BC and the maximum velocity. Basically, it is how long the bullet tip is exposed to what level of temperature. The higher the muzzle velocity the higher the maximum temperature on the tip. The higher the BC the longer the tip is exposed to higher temperatures. The longer the exposure and the higher the temperature, the more tip deformation will occur.

Q: At what temperature do standard tips melt?

A: Every bullet manufacturer's tips begin to melt and deform depending upon their specific material properties. In general, standard Acetels and Delrins, currently used in bullet tips, begin to soften and deform at 150-200 degrees (F). At 250-350 degrees (F) they will begin to melt and badly deform.
The LONGER the exposure to these types of temperatures the more deformation will occur. This generally begins to occur from 50-100 yards of the bullet leaving the muzzle. Even though the effect is measurable with Doppler Radar early in the bullets flight, the effect on point of impact for ranges out to approximately 400 yards is small enough it can't be exposed during shooting. Time of flight is not long enough from 0-400 yards to expose the increase in drag that is measured by point of impact. Beyond 400 yards however, the time of flight becomes long enough that the increase in the drag due to tip melting can be exposed during shooting and will result in vertically elongated groups and a lower point of impact than predicted.

Q: Why didn't you put the Heat Shield Tip in all of your other tipped bullets?

A: Doppler Radar testing has shown that tip deformation/melting occurs out to ranges of 500-600 yards depending on the bullet BC. Bullets designed for conventional ranges of 0-400 yards such as the SST do not have long enough time of flight over these distances to show a significant effect of tip deformation in a field shooting environment. However, at longer ranges and time of flight, these effects become substantial to bullet drop, wind drift, terminal performance and accuracy due to increased drag and drag variability. Click here for more information on Hornady Heat Shield Technology.

Q: If your tipped bullets are so good, why should I buy your BTHP Match bullets?

A: For match use many shooters find that one bullet shoots better in their specific rifle than others. BTHP bullets provide another option for match and target shooters to tune loads for the specific application.

Q: How can you claim such high BCs?

A: All BC's were determined using Doppler Radar by measuring bullet velocity as a function of distance to ranges of up to one mile. Doppler Radar provides velocity measurements roughly every one to two feet of the bullet's flight resulting in exact measurements of velocity loss due to drag. By the use of state of the art aeroballistics software (6DOF) large amounts of data can be analyzed and computed to provide extremely accurate determinations of projectile drag.

Q: If tips melt, why wouldn't I just shoot targets and animals with non-tipped BTHP bullets?

A: The new Heat Shield tipped bullets provide both aeroballistics and terminal performance advantages. The class leading ballistic coefficients provide flatter trajectories, less wind drift, and higher impact velocities. The ELD bullets provide terminal performance far superior to traditional bullet designs over a much wider range of velocities. Repeated laboratory and field testing has shown that BTHP bullet designs do not provide reliable or predictable terminal performance. Hornady does not recommend the use of BTHP bullets, regardless of the manufacturer for big game hunting.

Q: Are you encouraging people to shoot animals at long range?

A: No, we are simply providing a bullet that is capable of excellent terminal performance, accuracy and reduced wind drift that is lethal at ranges from near and far. It's our opinion that you should get as close to your quarry as possible. In certain instances, you simply shouldn't take the shot.

Q: What is the maximum range for acceptable terminal performance with ELD bullet?

A: This is dependent on retained velocity and is therefore cartridge dependent. In general, the ELD bullets will provide reliable and effective terminal performance to velocities of approximately 1,600 fps.

Q: If the BC degrades with older tip material how accurate are trajectory predictions?

A: Beyond ranges of 300-400 yards they become progressively more inaccurate. Although the efforts of a changing BC with distance can be modeled with several commercially available ballistic calculators, it is virtually impossible to know what the actual BC changes are without Doppler Radar data. Reducing velocity to measure the simulated ballistic coefficient in mid-flight does not reflect the effects of aerodynamic heating and its effect on the tip.

Q: Would the drop in BC you claim you are seeing be caused by the normal change in BC at lower velocities that we all know about?

A: No, it does not. The drop in BC associated with a bullet flying down range as it slows down is driven by two things. First, it is caused mostly by the drag coefficient versus Mach number (drag model) of the standard that is being used not being at all like the actual drag coefficient versus Mach Number of the projectile that is being evaluated. In the case of G1, at mach numbers above 2.0 the slope of the Cd versus Mach is fairly close to modern boat tail type projectiles and gives reasonable approximations. Below Mach 2.0 the G1 Cd vs Mach becomes more and more dis-similar to a modern boat tail type projectile and this is why the BC numbers drop. The problem is not as bad with the G7 drag model. Bottom line is that unless the projectile being evaluated matches the shape and Cd vs Mach of the standard projectile being used errors are going to occur. The phenomenon we were seeing was happening immediately and was happening rapidly. It was totally inconsistent with the known problems with using BC. Secondly, another problem arises when testing is done to determine multiple BC values. Testers usually take a standard twist rate for a given caliber and down-load to shoot at lower velocities. This results in abnormally slow spin rates on the projectile being tested for the velocity it is travelling, which changes the gyroscopic stability, muzzle tip off, body shank wear and limit cycle yaw, further muddying the whole BC issue. The spin of a projectile typically drops off at a dramatically slower rate than its velocity, causing an increase in gyroscopic stability (Sg). For example, using the PRODAS 6 degree of freedom (6 DOF) trajectory analysis the 6.5 mm 140 ELD™ Match projectile, discussed below, fired from a 1-8” twist barrel at 2,780 fps has a spin rate of 26,272 rad/sec at the muzzle. At 800 yards the projectile still has a spin rate of 22,145 rad/sec, nearly 85% of the muzzle value. Yet the retained velocity is only 1,825 fps, 65% of the muzzle value. If the same bullet were fired from the same twist barrel at 1,825 fps the spin rate would be 17,214 rad/sec, 22% less than it should be at that velocity. This also makes the stability of the bullet 22% less than it should be at that point in its’ trajectory. Limit cycle yaw will be discussed below. We never used G1 from the beginning because of its gross differences in drag characteristics to the aerodynamically efficient projectiles we were testing. This problem with BC’s is why you will see us discussing projectile performance from now on in terms of the Drag Coefficient. It is the radar generated exact total drag for the projectile being evaluated.

Q: You don’t report twist rates in any of your results. Would insufficient spin rate cause what you are seeing in the drag behavior of some of these projectiles?

A: In extreme lack of gyroscopic stability (Sg) situations, effects similar to what we witnessed could contribute to the effects we observed. Extensive radar testing proves this is not what is occurring. We perform extensive bullet modelling for both mass and aerodynamic properties using a state of the art, military grade software called PRODAS that has been in use since the early 1970’s. This allows extremely accurate and high definition modelling of projectile flight performance and predictions of stability. We have been using this software since the early 1990’s. We have been using (Sg) for analysis of projectile stability and determination of appropriate twist rate for several decades. We generally design for a worse case Sg of 1.5 under cold, dense atmospheric conditions to allow margin for variability in twist rates. All projectiles tested and data that has been presented were tested under conditions where the Sg was in the 1.8 to 2.1 range. For example the graph shown in our technical paper for the 7mm 175 grain Hornady and Nosler bullet were fired from a 7mm Rem Mag with a 1-9.25” twist and the Sg’s were 2.05 and 1.95 respectively for the atmospheric conditions they were fired in. To further put this question to bed, Figure 1. shows the radar generated Cd vs Mach number graph at supersonic Mach numbers for identical 6.5 mm 140 grain ELD™ Match projectiles that were literally made serially with the only difference being the tip material. They were both fired from the same 6.5 mm Creedmoor rifle at approximately 2,780 fps, with a 1-8” twist, within seconds of each other. The Sg for these projectiles in the atmospheric conditions they were fired in was 1.80. These projectiles had enough spin to be adequately stabilized.

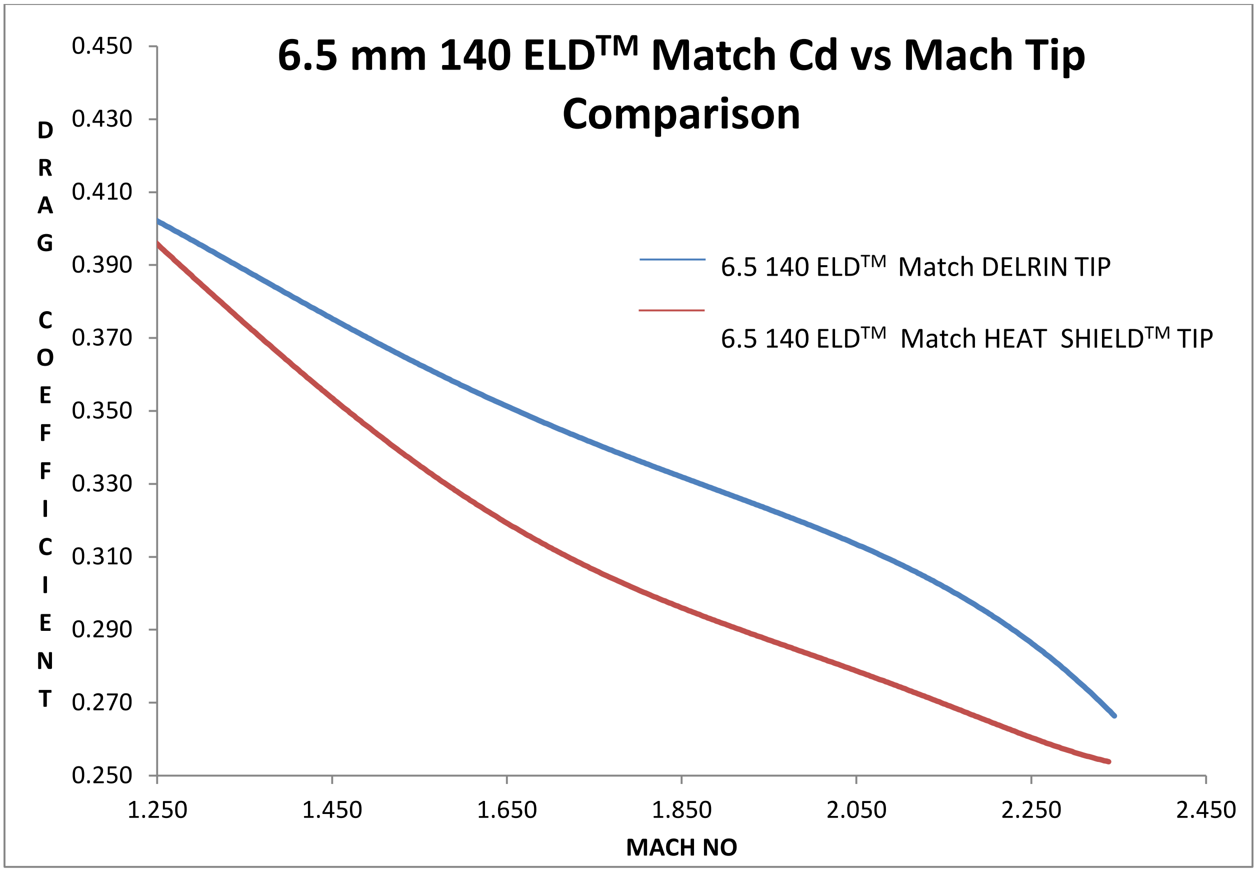

Figure 1. Cd vs Mach 6.5 mm 140 ELD™ Match Delrin and Heat Shield™

As can be seen from the graph The Heat Shield™ tipped projectile has a very normal looking drag curve. The Delrin tipped projectiles immediately sees a rapid rise in drag as compared to the Heat Shield™ projectile and maintains this higher level of drag offset until low supersonic Mach numbers where the Meplat diameter has much less of an effect on drag. The two plots do not start at the same place at high Mach numbers because of the separation, offset, between the radar head and the rifle. (You can't shoot through the middle of the radar head - that would be a very expensive mistake.) It takes the projectiles 40 – 50 yards to fly into the radar beam. The projectiles are acting exactly like they should for what is happening to them, or not happening to them. At this point we must stress that this phenomenon is happening to **everyone's** polymer tipped projectiles, not just ours.

Q: Couldn't limit cycle yaw cause what you are seeing with the drag coefficient at supersonic velocities?

A: If limit cycle yaw was the root cause of the observed increase in drag short range, we would have seen the same drag signature regardless of tip used. With anything other than a grossly under-stabilized projectile, no. Limit cycle yaw is a phenomenon associated with some projectiles where because of their shape and their stability they begin to fly with some persistent level of yaw. This phenomenon occurs almost exclusively at long ranges at low supersonic or subsonic Mach numbers. The shape of the boat tail plays into this because of the aerodynamic changes that are occurring to a bullet as it gets nearer to

Mach 1.0. Short or steep boat tails tend to exacerbate this problem. Remember though we are talking low supersonic mach numbers when a projectile is a LONG ways from the muzzle. We are also talking about projectiles here that do not have short or steep boat tails. Figure 2. shows the radar generated Cd vs Distance graph at supersonic Mach numbers for the same 6.5 mm 140 grain ELD™ Match projectiles discussed above. As can be seen from the graph the Heat Shield™ tipped projectile has a very normal looking drag curve. The Delrin tipped projectiles immediately sees a rapid rise in drag as compared to the Heat Shield™ projectile and maintains this higher level of drag offset until low supersonic Mach numbers where the Meplat diameter has much less of an effect on drag. The two plots do not come back to the same starting point because of the separation, offset, between the radar head and the rifle.

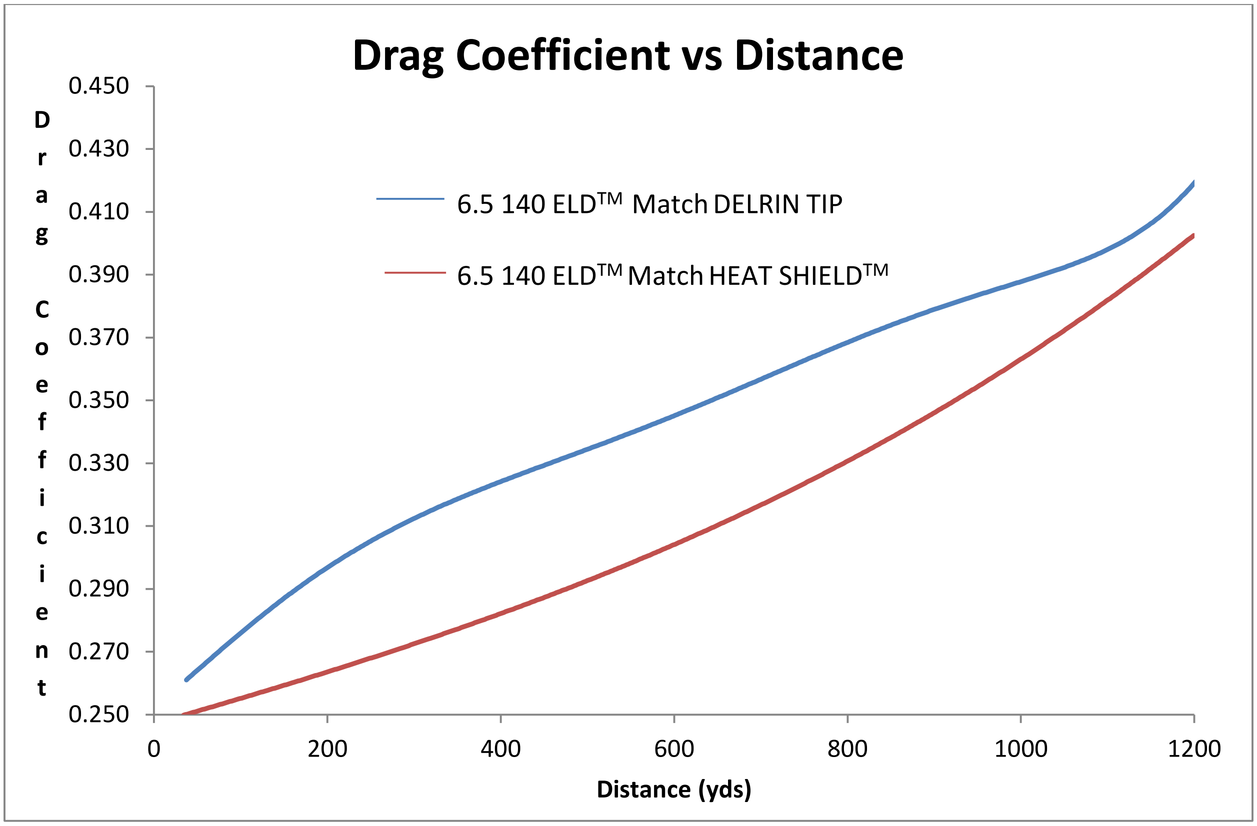

Figure 2. Cd vs Distance 6.5 mm 140 ELD™ Match Delrin and Heat Shield™

The yaw necessary to produce the drag effects seen in the Delrin tipped bullet would have to occur at the muzzle and be nearly 10 degrees in order to produce the initial performance observed. This type of yaw would have been readily evident on yaw cards placed down range and it is not. Furthermore, with the Sg this projectile was fired at, by using a 6 degree of freedom trajectory calculator this initial yaw would be damped to less than .5 degree by 250 yards. The drag curve for the Delrin tipped projectile would show an initial convex "bubble" on the curve out to about 200 yards and return to essentially the same curve as the Heat Shield™ tipped projectile by 300 yards if in flight yaw near the muzzle was the source of the observed drag increase. The phenomenon being observed can only be accounted for by a rapid and sustained change in the shape of the projectile, the polymer tip.

Q: Why are the drag curves convex nearly immediately when you say that the effects are only significant at longer ranges?

A: For most projectiles the effect of the tip beginning to change shape is nearly immediate. From the graph of the Cd versus Distance above you can see that the change in the drag of the projectile starts to happen immediately and accelerates until it stabilizes at about 300 yards. Remember, this is for a high BC bullet, over a .300 G7. The effect is short lived and not as severe for lower BC projectiles. With low BC projectiles, like varmint bullets even at high velocity, the effect is virtually nonexistent. It should not be hard to visualize that a change of 4-6% in the drag of a moderate BC projectile over 200- 300 yards, that is intended for 300-400 yard shooting would not see much effect on the ballistics. However, a change of 8-12% on a bullet intended to be fired to ranges of 800-1,000 yards will see a far greater effect on its' ballistic performance. Drop and wind drift are a function of projectile drag and time of flight. Using JBM ballistics and Doppler radar data for the two projectiles discussed above, the Delrin tipped projectile has a G7 of .281 over 400 yards and .273 over 1,000 yards. The Heat Shield™ tipped projectile has a G7 BC over 400 yards of .312 and a G7 BC of .301 over 1,000 yards. This shows the change in BC, of any standard, that does not match the drag performance of the projectile it is attempting to model. This is why drag coefficient is the only way to accurately analyze what is happening. Using the above G7 radar calculated BC's the difference in point of impact for the two projectiles at 400 yards is .2 moa. The difference in point of impact of the two projectiles at 1,000 yards is 1.9 moa. This is why we say it doesn't really matter at shorter ranges but is very important for longer range shooting. Calculating trajectories using the actual Drag coefficient vs Mach the differences at distance are even greater. Shooting the two different projectiles at 400 and 1,000 yards gave results very close to those calculated. The effects, at shorter ranges, for lower BC projectiles is even less. This is why we say for existing standard type hunting and varmint projectiles, with current tips, this just really **doesn't matter**. That is **NOT** the case for long range match and hunting shooting situations.