Creating Winning Long-Range Ammunition with the Dillon 550 Press
&
Prometheus Powder Scale

By

Scott Harris

scott_harris64@yahoo.com

Purpose

Ammunition of the highest quality is needed to perform well in F-class, especially for long-range events. Reloading problems that do not impact group size at less than 600 yards, are the source of many lost points at 800 to 1,000 yards. In short, it is essential to carefully control all aspects of the manufacturing process to ensure the finished cartridges are virtually identical in every measurable dimension. The purpose of this article is to share some the techniques we use to produce ammunition suitable for long-range F-Class

Our family uses a LOT of ammunition each year in competition. So, minimizing reloading time and effort is almost as important to us as the need to create "perfect" ammo. Laborious, time-consuming methods that might be acceptable for lower-volume competitors simply do not work when shooting 300-1000 rounds per week.

This paper will describe two of the important tools we use to make quality rifle ammunition in the shortest time possible:

- Dillon 550 Progressive Reloading Press
- Prometheus Automated Powder Measure (Gen 2)

Specifically, we will cover the competition-proven "tips & tricks" we have developed over several years of F-class competition.

Ammunition Criteria: how we measure our production results

Key traits of match-winning long-range rifle cartridges:

- **Primer Seating**: all primers seated slightly (.003 - .006) below flush and to the bottom of the primer cup with 100% consistency.
- **Sized Brass Concentricity**: sized brass should have zero runout with a maximum allowed runout of .001 measured anywhere along the case length.
- **Neck Tension**: neck tension must be identical from case to case. This is accomplished by trimming, chamfering, annealing, and sizing the neck no more than needed. In addition, turning/expanding mandrels (or expander button) are used to improve inside neck uniformity. Lubricity of the neck must be carefully controlled. Bottom line: consistent neck tension is one of the most important ingredients needed to produce superb accuracy.
- **Powder Charge Weight**: top long-range competitors control the powder weight to within +-.02 grains. Every single cartridge produced has the same powder weight with a maximum spread of +-.02 grains.
- **Bullet Seating**: should be perfectly consistent, as measured by bullet runout and seating depth consistency. Cartridge runout, measured on the bullet, should be .002 or less. Seating depth, measured with a bullet comparator, should be within +- .001.
- **Brass & Bullet Quality**: beyond the scope of this article, but essential. It's best to start with components of the highest quality. Lapua brass and Berger bullets work for us!

Next, we will describe how the Dillon Progressive Press and Prometheus Automated Powder Measure are used to produce ammunition meeting these high production standards.

Dillon 550 Press Modifications

Many reloaders think of the Dillon 550 as a tool for high-speed pistol production, but not one that can create match-winning long-range rifle cartridges. In fact, a number of top high power and F-class competitors are indeed using Dillon 550 and 650 presses: with a few modifications. Once these improvements are made, I can assure you that a Dillon 550/650 will produce ammo competitive with anything on the firing line. So, let's get started.

Shell Plate Modification

Even when tightened as much as possible, the Dillon shell plates allow a considerable amount of case wobble. While this play is mostly a good thing, it does cause problems with primer seating. Case wobble can cause the primers to be seated slightly crooked: not good for accuracy. To fix this problem, grind some material (.005-.015") off the bottom of the shell plate as shown in the picture below.

This is easily accomplished with a sanding block and elbow grease. Continue to remove material until the shell plate can be tightened such that cases are completely immobilized. In this way, you will know enough material has been removed. Then, you will adjust the tension so that cases can move freely, but with the minimum amount of slop and wobble in station 1 (priming).

The pictures below highlight the improvement in case tilt achieved after grinding the shell plate and tightening it properly. Primer seating consistency is greatly improved with this change.

BEFORE:

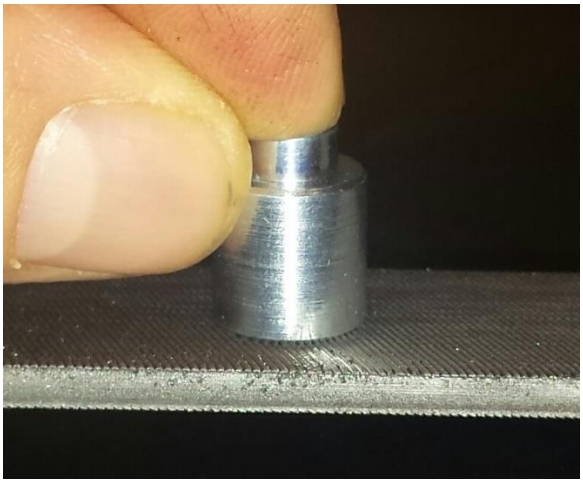
AFTER:

Adjusting Primer Seating Depth

It is essential to seat primers firmly to the bottom of the cartridge case primer cup. Failure to do so will result in inconsistent ignition and poor accuracy. In general, primers should be seated .003 to .007 below flush in the case and this can be roughly measured with a decent set of calipers as shown below:

The Dillon 550 priming assembly often does not seat primers deeply enough to accomplish this task correctly. Fortunately, there is a way to increase the seating depth if needed.

Primer seating depth is controlled by the Dillon 550 primer seating cup as shown below. Specifically, the distance between the bottom of the cup and the shoulder controls the seating depth. To increase seating depth, carefully file/grind one or two thousandths off the bottom of the primer cup as shown in the picture below



The result is the primer seating depth is increased by the amount of material removed from the bottom of the cup. The before and after pictures below show primer seating depth being increased by .004.

BEFORE:

AFTER:

Be careful to remove only a small amount of material at a time and then test primer seating. It is very easy to remove too much material from the bottom of the cup. I had to purchase a few spare cups before getting it right. ☺

In summary, by correcting case wobble and seating depth, the Dillon 550 can be made to seat primers perfectly with almost complete reliability. All of our match ammunition is primed on the 550 press.

Dillon Press, Station 1: Full-length Sizing & Priming

Virtually 100% of our sized brass has zero runout

A few simple steps will enable you to do the same.

- **Use a zero-runout, full-length, non-bushing sizing die.** It's impossible to produce sized cases with zero runout if the die itself is less than perfect. Many factory dies have runout. Bushing dies commonly induce more runout

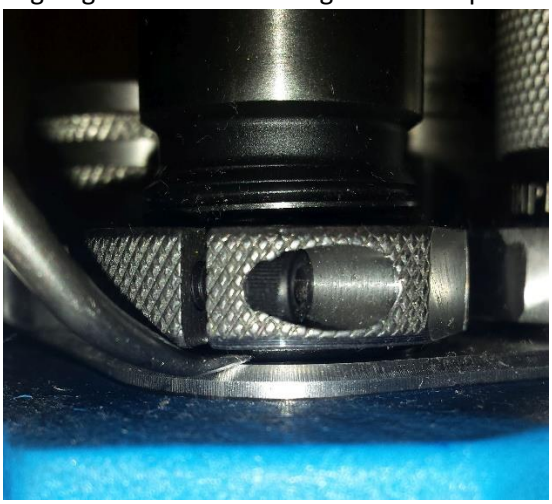
than non-bushing dies. In my experience, the most fool-proof sizing method is to use a custom full-length non-bushing die. To determine if your current die is good enough, simply measure case runout before and after sizing. If your case has more runout after sizing than before, there is a good chance the die is the culprit.

- **Float the sizing die.** Allowing the die to float and self-align with the case produces the best concentricity. This is accomplished on the Dillon 550 by using the Uniquetek floating die toolhead. This is actually a Whidden floating die toolhead with clamping screws added by Uniquetek.

Uniquetek/Whidden Floating Die Toolhead

The best way to use these toolheads is to have one per cartridge as shown below. This way, you set up your dies once and that's it. Switching cartridges is as easy as sliding one toolhead out of the press and sliding the new one in.

Notice, below, that the locking ring floats slightly above the toolhead enabling the die to slide/tilt a bit, thereby self-aligning with the case being sized. This produces better runout



The next picture shows the roll pins inserted through the die locking rings. This prevents the loosened lock rings from moving too much.

- **Remove the expander button from the sizing die**. This is the final step to produce zero-runout sized brass. The expander button is sometimes a source of runout in sized cases. We prefer to use mandrels (station 2) in place of the expander button because they perform the same task with a lower chance of creating runout.

"Floated," custom, full-length, non-bushing sizing die = 0 runout

Dillon Press, Station 2: Mandrel

The second press station contains a Sinclair Gen 2 Mandrel die. Depending on the desired amount of neck tension, a turning, or expanding, or even a custom-sized mandrel can be used. We typically size the inside of the brass necks to .003 less than bullet diameter and then use a carbide turning mandrel which is .002 less than bullet diameter. This means we only size the necks the minimum necessary and that the mandrel lightly expands the case neck. The goal is to

use the mandrel as the final step to produce the most consistent neck tension. We prefer carbide mandrels as they require no lubrication. Regular steel mandrels often gall the case necks without lubrication…..very bad for accuracy. The Sinclair Gen 2 die allows the mandrel to float and no runout is induced during this operation.

It is important not to size the case necks too small because this forces the mandrel to do a lot more work than necessary. This, in turn, can cause even the carbide mandrel to gall and also creates runout. .003 under the loaded round diameter is the maximum we size our case necks.

Sinclair Mandrel Die (floating)

Carbide Mandrel (.002 < bullet diameter)

Dillon Press, Station 3: Powder Drop

Powder is dropped into the case at station 3. Our long-range ammunition MUST have a standard deviation of 7 fps or less when measured over a 20-shot string. A powder measure, regardless of the quality, simply will not get the job done. So, we use a Dillon powder die which allows powder to be manually thrown after the charge has been weighed separately on a high-quality scale: i.e. something similar or better than the Sartorius GD-503 or Entris 64.

"Old Trusty," Sartorius GD-503:

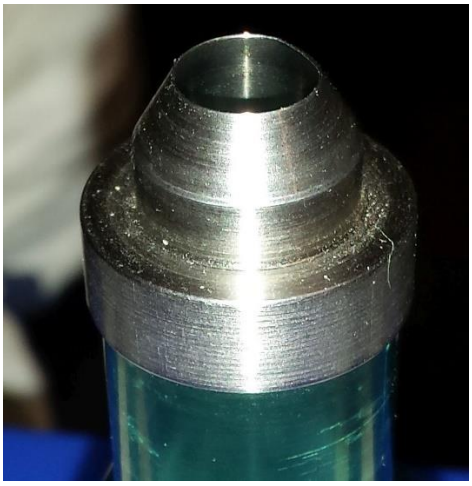
Previously, we used the GD-503 to weigh powder, but that requires a second person to participate in the reloading process. We have eliminated the need for a second person by using a Prometheus automated powder scale which will be discussed in the next section.

Powder Drop Problem #1: hanging kernels

One problem that occurred at this station was random “powder loss.” This is a very subtle problem and it took a long time to identify (aka years). We learned that a few stray kernels of powder would sometimes hang in the powder die leaving that case charged a little light. Those extra kernels would then fall into another case at a later time, making that charge slightly heavy. So much for weighing to the nearest kernel with an expensive lab-grade scale!

The source of the problem can be seen in picture below. A small gap between the powder die body and the cartridge-specific insert created a ledge for powder to get hung up in:

If powder can get stuck somewhere, it will get stuck somewhere! We resolved this problem by creating a steel insert that completely covers the gap, thereby preventing any powder from hanging up. The picture below shows the insert:



You could probably bed this gap to achieve a similar result if you did not want to make an insert.

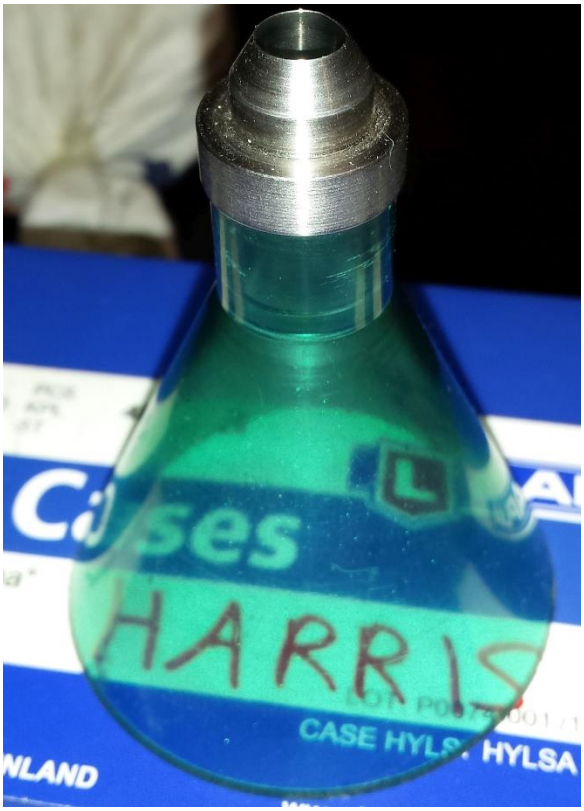
Powder Drop Problem #2: bridging

The second problem at this station is random bridging of powder in the die. In other words, powder sometimes fails to drop into the cartridge case, instead getting stuck in the die. This occurs most commonly with the 22 cal and 6mm cartridges. A quick tap on the powder die usually fixes this issue. But, detecting bridging is the real challenge because the Dillon funnel is solid black and it usually takes two powder charges to be dumped before you can see it in the funnel. So, we needed to come up with a way to immediately detect when bridging occurs. This was done as follows:

Modify Powder Die Insert

The powder die insert was modified to allow the die to be screwed down as low as possible into the press. We drilled out the bottom of the die insert to allow the case to go higher up into it…which actually let us screw the powder die lower. The net effect is the distance between bottom of the funnel and top of the cartridge case is minimized. Now, when bridging occurs, the bridged powder column extends up into the (clear) funnel area where it can be easily seen.

Created See-Through Powder Funnel



The standard Dillon powder funnel is a small black plastic piece that you cannot see through. We customized a clear RCBS funnel to work with the Dillon press as shown here. We made a steel insert that was glued to the modified funnel and allowed it to fit perfectly in the Dillon powder die:

Dillon Press, Station 4: Bullet Seating

Toolhead Modification

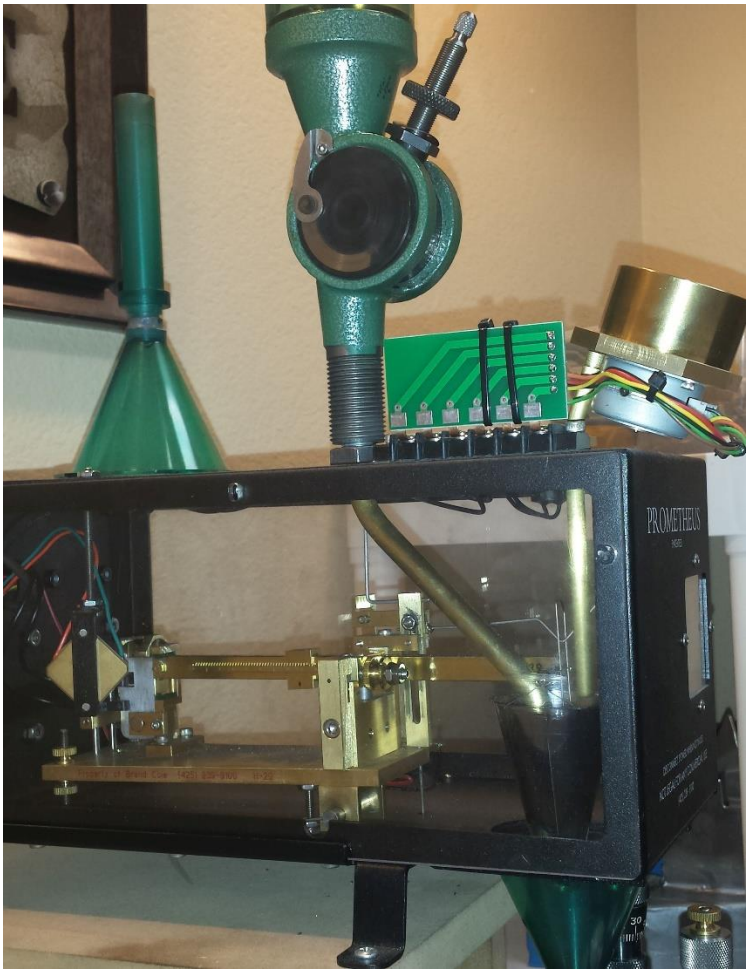
The seating die must be floated at this station for best concentricity. Unfortunately, the Whidden tool head only floats stations 1 & 3 out of the box. So, we used a drill and roll pin to float station 4 just like 1 & 3. In fact, I decided to make it simple and modified the toolhead so all four stations float. It is a simple process, you just need to be careful. A drill press makes this task much easier. You will also need to create two more modified die lock rings. The end result is all four stations float the dies.

Seating Die Modification

The Dillon 550 toolhead positions the 4 dies fairly close together. In fact, the powder drop funnel was bumping into the seating die. So, I modified my Redding seater head/top as shown in the picture below to create necessary clearance.

That's it! The Dillon 550 is now capable of loading near perfect ammo. Next, I'll describe how we use the Prometheus Powder Measure to greatly speed up the reloading process while still measuring charges to the nearest kernel.

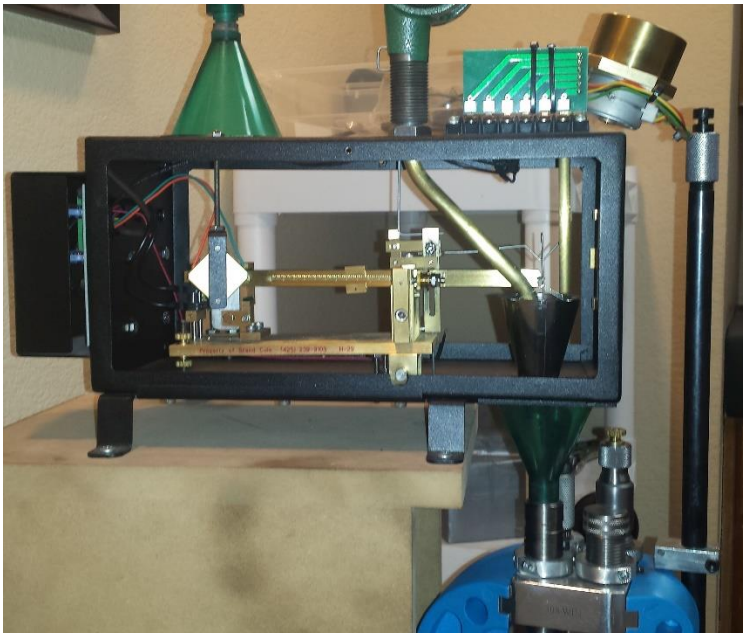
Prometheus Automated Powder Measure



Dropping powder is one of the most time-consuming reloading tasks. Fortunately, the 2nd generation Prometheus, made by Brand Cole, is an amazing machine that automates this process while maintaining to-the-kernel accuracy round after round. We have carefully tested this machine over several months, throwing more than 1,000 charges and then checking the weight with a Sartorius lab-grade scale. Our conclusion: the Prometheus is 100% reliable….or as close to it as any machine can come.

Initially, we planned to double-check every charge thrown by the Prometheus on the Sartorius scale for the important matches. We simply cannot risk even a single charge being off. However, after checking the thrown charges month after month, we've come to the conclusion that the Prometheus is just as reliable and precise as the Sartorius GD-503: i.e. near perfect. So, now, Prometheus-weighed charges go straight into the case without being checked: for big matches and small.

NOTE: we do weigh finished cartridges for the big matches to ensure they all have powder. It's embarrassing when firing a squib load in competition! ☺ This task goes very quickly when using the Sartorius scale.



To maximize the potential of the Prometheus, we have mounted it directly over station 3 of the Dillon press. A weighted box was created to securely mount the scale at the correct height over the press. Then, we modified the green funnel so it comes up just underneath the bottom of the Prometheus to prevent any kernels from spilling. The result is a simple system to reliably drop powder directly into the cartridge case: The clear funnel enables us to immediately detect and resolve any bridging problems and the metal funnel insert ensures all kernels drop where they belong without hanging in crevices.

This setup enables us to load 2.5 to 3 rounds per minute with a single person. Previously, we could load at the same rate using the Sartorius scale, but it required two people.

Before, two people:

After, one person:

Eliminating the second person has saved countless hours at the reloading bench. Actually, we can count the number of hours. ☺

15,000 rds/year x 20 seconds/rd = 300,000sec x 1hour/3600sec = 83.3 hours per year. In other words, this little baby is freeing up two work-weeks of our life per year. Expensive? Maybe. Worth every penny? Absolutely!

Appendix A: Our Reloading Process, Step by Step

1. Club Matches
    a. Tumble in corn-cob media for 6-8 hours
    b. De-prime with Sinclair decapping die (using cheap Lee press in garage). Doing so after tumbling ensures the flash hole is cleared of corn cob media.
    c. Lube cases with Hornady One Shot and Sinclair lube racks
    d. Dillon Press
        i. Station 1, full-length size (.003 under bullet diameter), seat primer
        ii. Station 2, expand with carbide turning mandrel (.002 under bullet diameter)
        iii. Station 3, drop powder
        iv. Station 4, seat bullet
        v. Wipe lube off with small towel- ready to fire!
2. Club Matches, every 3rd or 4th Firing
    a. Tumble in corn-cob media for 6-8 hours
    b. De-prime with Sinclair decapping die
    c. Anneal with Benchsource machine
    d. Lube, full-length size, and use mandrel
    e. Trim with Giraud machine
    f. Re-lube with One-Shot
    g. Dillon Press: exactly the same as in 1.d. above
3. "Important" Matches
    a. Start with brass fired once after annealing (previously had some inconsistencies using freshly annealed brass…mainly neck lubricity)
    b. Tumble in corn cob 6-8 hours
    c. De-prime
    d. Lube with one-shot
    e. Full-length size, use mandrel
    f. Trim necks with Giraud
    g. Run a plastic bore brush once through the neck
    h. Re-lube cases
    i. Dillon Press
        i. Full-length size & prime
        ii. Mandrel
        iii. Drop powder
        iv. Seat bullet (bullets are sorted by bearing surface & have been pointed (not trimmed)
    j. Weigh all cases to prevent squib rounds

Appendix B: Other Accessories

The following additional accessories are used on our Dillon 550. I do not consider either of these essential, but they serve a purpose and I like them:

1. 550 Primer Track Bearing: http://www.uniquetek.com/site/696296/product/T1571
2. 550 Turbo-Bearing: http://www.uniquetek.com/site/696296/product/T1281