

# Incremental Load Development Method

by Randolph Constantine

When you get a new rifle or have an old one re-barreled, or do anything else likely to change the barrel vibration characteristics, such as hang a Bloop tube on it, or shorten it, or usually "developing" a load for it becomes necessary. Another thing that will require you to develop new Loads is changing over to moly-coated bullets, like I did this past year to compete in High-power. To develop a new load usually means, to find something pretty close to the most accurate load for the rifle, unless you're considering some other really special application.

Unless you need bullets to fly supersonic at 1000 Yards. or enough momentum to stop a charging Cape Buffalo, muzzle velocity usually takes a back seat to accuracy. To find a load that will shoot a Buffalo accurately at 20 yards is not hard to do. But to find a load for the .308 that will still be supersonic at 1000 yards and also shoot accurately at that distance the same time can be a bit of a problem. However, it is possible. The method described here can help.

## Load Development the Old Way

For many years the classic method to develop loads was to start with a particular bullet, powder, and primer, load five rounds with a supposedly safe start load and to shoot a group. If the pressure signs (primer appearance, case head diameter, bolt lift effort, etc.) seem to be normal, or at least not excessive, try another five-round-group with 0.5 grains more powder, of course, the same powder. I assume everybody knows, if 40.0 grains of 4895 are OK, you don't try 40.5 grains Bullseye and live to tell about it.

In the old days, you continued the process until groups tightened up significantly or until you had to pound the bolt open with a mallet. In that case you went to get a can of a different powder. Nowadays, the sophisticated among us stop when the case head shows 0.0003" expansion, measured by a good micrometer that enables you to measure things to a ten thousandth Inch.

If you did not get the kind of accuracy you wanted or expected, you tried another powder, or primer, or bullet and started all over. Sometimes this process would have worked very fast. Sometimes it would not. When this procedure did not produce the accuracy sort you are looking for, you ended up burning up a large amount of components and put more rounds than you wanted to through your barrel before you either found a load that worked to your satisfaction, or you decided the new rifle or barrel is a stinker

The number of rounds you might have to fire before you find a good load can be a significant percentage of your accurate barrel life. When you try to develop a load for a

Magnum intended to be used for 1000 yard competition. There is a better way.

## The Incremental Load Development Method

There is a load development process I used more than 10 Years that can tell you quite a lot about a rifle and that kinds of components it likes and at what velocity levels it will shoot best. I first read about this method in an article by the late Creighton Audette entitled, "It Ain't Necessarily So". This article appeared in the NRA's National Championship Training Clinics Manual Series in the volume, High-Power Rifle Shooting, Volume III. I never saw this load development method mentioned anywhere else, although Creighton may have published something on it in Precision Shooting back before I became familiar with the Magazine.

I once commented that some of these NRA manuals had been out of print, for indeed some of them had been. The NRA has informed the Precision Shooting editor that all three of the High-Power manuals are now back in print. These manuals contain a wealth of Information for High-Power shooters, not found anywhere else.

I tried Creighton's method. It is simplicity itself and certainly seemed to work well enough to tell me which loads would give me the best accuracy in my rifles at reasonable velocities and pressures with a particular bullet.

Creighton Audette's Incremental Load Development Method (or ILDM for short) essentially is: Choose a bullet, primer, powder and case brand. Once you have chosen these things, there are two numbers you need to choose to use this method: A starting load and a load increment. With that chosen, load 20 rounds, start with the starting load and increase the charge weight stepwise by the increment you chose for each subsequent round. Load only one round with each charge weight. Then, using the same aim point, fire all these rounds on one target and interpret the results. Here are the details.

For medium case capacity cartridges such as the .308 Win. or .30-06 Sprg. Audette's standard increment was 0.3 grains. For small cases such as the .222 Rem, .223 Rem and the like, use 0.2 grains. For medium-large Cases such as the .30-338, 0.3 shall also do. For really large cases, so large that I don't know of anybody who is crazy enough to bench test them a lot, pick anything you like, 0.5 or even 1.0. It's your Shoulder.

Your start load (charge weight) should be simply the maximum charge weight for that cartridge with that bullet minus a decrement, that is 20 times the increment. Example: If you choose an increment of 0.3grs., the decrement would be 6.0 (= 20 times 0.3). In this example the decrement would be 6 grains. Make sure your starting load is a safe load. If you use a really slow powder, such as 4350 or slower, do not go below the recommended minimum load for that powder to avoid the risk of secondary explosion. The secondary explosion effect occasionally occurs with light loads of slow powders, or partly empty cases. It does not happen every time, but is frequent enough and dangerous enough, that almost all load manuals now list minimum charge weights. For you safety, never charge a case with less than the minimum recommended charge for

a specific powder.

Next, load up a set of test rounds by loading only one round, that's right, only one round, with each charge weight. Start with the starting load and load one round. Then load the next round with 'starting load + Increment'. The next round would be starting load + increment + increment. The next, starting load + increment + increment + increment. You step up a Ladder. An example will make this clearer.

Example: If the starting load were 40.0 grains of 4895 and your increment is 0.3 grain, You would load the 1<sup>st</sup> Round with 40.0 grs., the 2<sup>nd</sup> with 40.3, the 3<sup>rd</sup> with 40.6, the 4<sup>th</sup> 40.9, the 5<sup>th</sup> 41.2, the 6<sup>th</sup> 41.5, and so on ... . Twenty incremental loads will take you the Ladder up from 40.0 to 45.7 grains in 0.3 grain steps. When loading it is important to keep track of which charge is in each case. An easy way to keep things orderly is with a fine tip marker, like a Sharpie, write the charge weight on each case just before charging the case. Approximate weights are not good enough; weigh each charge to a tenth Grain (1/10 gr.).

Once you have 20 rounds loaded, store them in a shell box starting with the lowest charge weight incrementing to the highest charge weight. This way you know precisely what charge is in each particular shell. Marked cases are a good safe guard against confusion. Now starting with the lightest charge, shoot them in charge weight order. To learn the most information from your efforts, there are some precepts you should do prior to beginning the test. They are:

1. Start with a clean barrel and shoot about 5 fouling rounds, loaded with the starting load before you begin the ladder test. Shooting the fouling shots achieve several benefits: (1.) Fowlers allows you to get on target and gives you a chance to move your group on the target to a desired aim point. (2.) Fowlers give you a chance to properly adjust the position of your Chronograph screens. (3.) Fowlers fowl the barrel properly with powder foul from the powder used for the incremental Ladder test. This last item is important: After firing with one powder and then changing to another powder, even though both powders were from the same manufacturer, all too often a barrel needs as many as 4 or 5 rounds to "settle down". I don't know whether changing primers, while using the same powder would have the same effect, but it might. To begin with a clean bore and then to foul it with group shots with the starting load results in a controlled test beginning.
2. Starting with lightest charge round , shoot the ladder test rounds in increasing charge weight order. When you are approaching the maximum load level watch for signs of excessive pressure. If they appear, stop!
3. If possible chronograph all shots. Velocities should monotonically increase, but an occasional Oddball shot may yield an off-order-velocity. Logging velocities helps you to interpret the target. The chronograph has occasionally helped me to determine the powder charge, when I shot a round out of order.
4. This step is the key to the method: Shoot all rounds on the same target using the same aim point. Number the shots and shot holes to identify which shot caused

which hole in the target. Make good notes. Always be sure to write down any pertinent data, such as the fact that you saw the crosshairs fade to the right, or down, or wherever for any particular shot. This information is needed to interpret the data.

5. Shoot the test at a goodly distance, at least 200 yards, but 300 yards is better. Creighton advised in his article to use 300 Yards. The problem at 300 Yards is that it is very difficult to identify the shots by number on a target that is that far away, unless you have a superior spotting scope, and it is a very calm day with no mirage, or use an electronic target system. The Ladder test can work at only 100 yards, but sometimes it is hard to discern what happens on the target. The first time I ever tried this method was at 100 yards with a new Obermeyer barrel that set 14 shots into a 1.25 Inch hole. That was kind of hard to interpret.

A 300 Yard range with target pits and pit pulley is the best scenario. Pull the target after each shot and number each shot hole with a pencil on the target face, or put numbered white Pastem's over holes that are in the black. At 200 yards, the shot holes can usually be seen, but when a tight cluster occurs it is hard to identify which shot is which.

At any distance on a pit-less range, you will have to resort to plot the shots by number on a target diagram. While you shoot have someone else watch the target through a spotting scope. Another good idea is to use Birchwood-Casey Shoot-N-C targets.

An important guide to successfully learn from a ladder test, is to set up the rifle exactly the same way as you intend to use it later on. This means, if you intend to use the rifle with a scope sight, then shoot the test with a scope on the rifle. If you intend to shoot from a rest, or other support, use the same rest, the same way.

If you are going to peep the target through iron sights (as in High-Power competition), then shoot the test with the iron sights you intend to use on the rifle.

If you shoot a ladder test with a rifle configuration set differently than the intended use, the rifle's recoil and vibration characteristics will differ enough that the load may not be optimum. Shoot any ladder test with the rifle set up the way you are going to use it! Exactly!

After you finished shooting the rounds, you will have two data collections, that when looked at together can tell you a lot about your rifle. They are: the data sheet listing the loads and their velocities and the target with the numbered shot holes, or the target together with a target diagram with shots numbered. The target with the numbered shot holes is the most important.

To plot shots on a target diagram and to have the target itself to compare to the diagram is very useful. Usually this helps to correct the diagram and enables to number most holes in the target.

## Interpreting the Data

I can hear the wheels turning in your minds out there. You all ask, "How in Hamburger Helper can this mess tell me anything. The answer is simple, but you need to know what to look for. While ignoring the chronograph results look first at the target. Are there any places on the target that produced a halfway decent group?

As velocity increases the shot holes will usually pattern upwards on the paper. The lowest velocity shot will usually hit the target lowest. The highest velocity shot will usually hit the paper highest. In this upward ladder there will usually be clumps or groups of shots. These are the most important of all. Sometimes the groups will be round, other times the groups will be vertical. If the test was performed in a windless environment and the holes scatter from left to right as well as up and down, it is probably time to try another powder or primer and/or check the bedding of the action in your rifle.

However, with any powder and primer combination the following usually happens. Within the 20 bullet impact pattern on a target, five or six consecutive shot groups can be found. This is not random. The numbered shot holes will march up the paper then stop for a few shots in a group before jumping out of the group and then resuming their upward march.

The key to interpreting the pattern are all numbered shot holes. You could shoot with all sorts mixed loads with different bullet weights, different powders and primers, different cartridge cases brands, etc., 20 shots at one target and probably get a few nice three or four shot groups and maybe even a small five or more shots group somewhere in the 20 hole pattern in the target, but that wouldn't mean anything. Even with all matched components and everything else done correctly with the ladder test, a small group would not mean anything, unless that group was made by consecutive shots in increasing weight charge order.

We only look for small groups formed by consecutive shots. We call such groups "Sweet Spots". In a Sweet Spot, the fired Rifle "cares not" about the powder charge weight, as long as it remains in a certain range. The ladder test purpose is simply to pick a charge in the middle of the Sweet Spot group charge weight range. One benefit to find a load with this method is, a load, tolerant to minor powder charge weight variations. Even if your powder measure technique is not accurate, the Incremental Load Development Method (ILDm) with the ladder test will show a load to be accurate with thrown charges.

## The Ladder Test works because ...

If you look at the reason the right way, it is simple. As the powder charge increases, the muzzle velocity also increases, but the time the bullet accelerates in the barrel (called barrel time) decreases. As powder charge and muzzle velocity increases, recoil also increases, whipping the barrel. I believe the recoil induced muzzle elevation interacts with barrel vibration and barrel time effects.

Several things occur at the same time:

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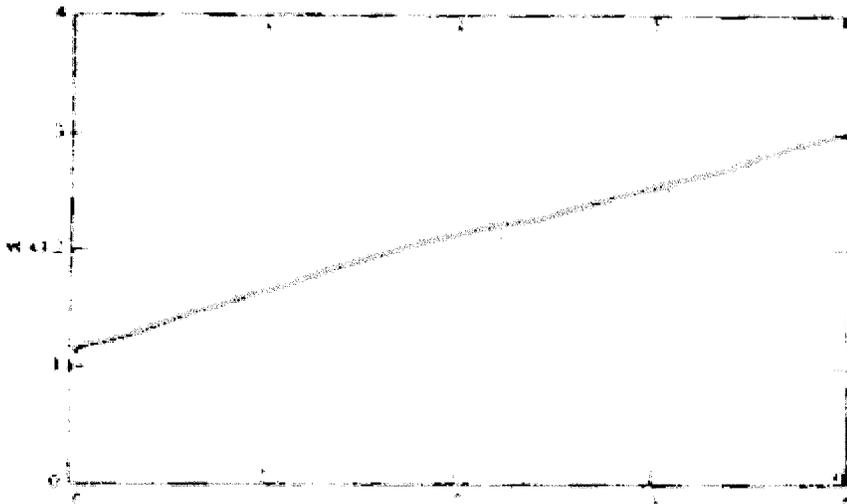
1. The recoil forces the barrel to move back and to rotate slightly around the rifle's mass center, whipping the barrel.
2. Responding to increased powder charges the stepwise further accelerated bullet increases velocity and reduces barrel time.
3. The barrel vibrates in some regular manner, changing the direction to point to.

The first two forces combine to produce a recoil effect. The second force combined with third force also produces a vibration effect. Recoil effect and the vibration effect combine to the total effect, to be seen as the target pattern. However, we need to look at these effects individually.

### The Recoil Effect

A way to understand the recoil effect is to idealize the situation. First assume the rifle barrel was indefinitely stiff and rigid. When fired two things happen together to produce the recoil effect:

- First the muzzle rises because the recoil impulse is along the line of the bore, but the rifle's mass center is below the bore line.
- Second under gas pressure, the bullet accelerates to a certain muzzle velocity within a certain time, then travels another certain time towards the target. Each of these forces magnitude is a function of the load's powder mass. For a particular rifle and bullet, muzzle elevation + barrel time + bullet flight time interact to determine the bullet impact point elevation on the target.



Recoil Effect as a Junction of charge Weight

Figure 1

Strangely, as the powder charge and muzzle velocity increase, muzzle rise due to recoil at bullet exit may, because of consequently decreased barrel time, slightly decrease.

Trying different loads with heavy bullets in a short barreled Revolver such as a Smith and Wesson Chief or a Colts Detective Special at short distances, lower speed bullets may sometimes hit the target higher. This effect is real. At close ranges slower bullets will hit higher on target than a faster same mass bullet. This happens, because the slower bullet spends more time in the barrel, while the gun rotates about its mass center, thus leaving the muzzle at a higher departure angle. However, since, for rifles the bore line change is usually small and faster, bullets fly in flatter trajectory, there will be a point at that bullet trajectories will cross, thus giving the same impact point on a target. If the target was closer to the muzzle than that of the trajectory cross, the slower bullet would impact higher than the faster bullet. At all distances beyond that cross, faster bullet would be higher than slower ones.

In short, if we shoot at a far enough target, the two effects: recoil induced barrel up rotation + flight time to the target, combine such, if the rifle barrel was infinitely stiff, not to bend or vibrate, for bullets fired at the same aim point, the target impact elevation points would increasingly depend only on muzzle velocity. Higher velocity bullets would strike the target higher than lower velocity bullets.

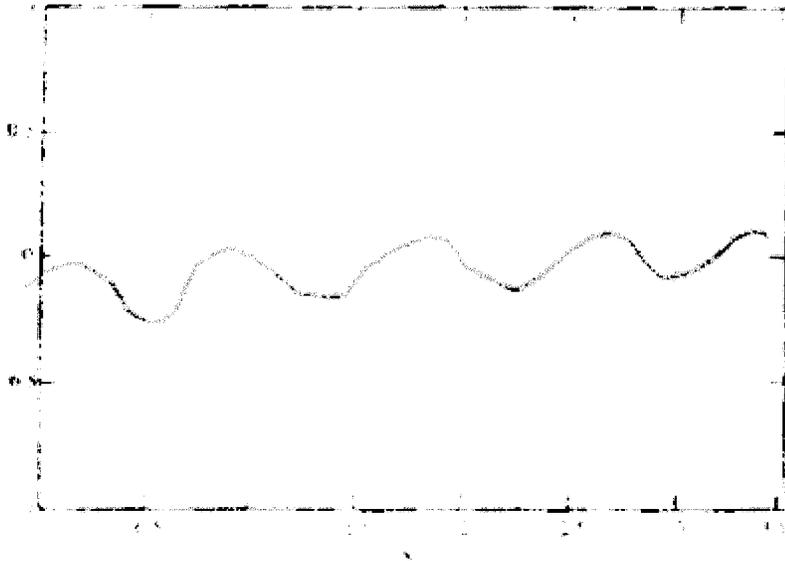
If the powder charge weights are in the normal range for that cartridge and bullet mass, then the muzzle velocity will also increase with powder mass. When we consider this fact together with that in the previous paragraph, to see that the impact elevation point on the target increases with charge mass becomes easy to see; i.e. more powder = higher velocity = higher impact point on target.

If we draw a target impact elevation point graph versus powder mass, we get a graph like shown in Figure 1. The actual target impact elevation point graph versus powder charge doesn't matter. Whether the graph bulges up or down doesn't matter. The significant Figure 1 feature is, the impact rises smoothly from left to right. For this reason, I chose a straight line for the purpose to illustrate the facts.

## The Vibration Effect

OK, back to reality. We all know, there is no such thing as an infinitely stiff barrel. That was the physicist's idealization. They all bend, wiggle and vibrate in all directions. However, for the purpose of this essay, I prefer to pretend all the barrel vibrations are simple. To understand the vibration effect, we also have to idealize to some extent. That idealization is merely to assume, everything is so uniform that, whenever two cartridges are loaded with the same amount of chosen powder and fired at the same aim point, the barrel vibrates with each shot exactly the same way and both bullets will hit the target in the same hole.

This assumption simplifies the vibration effect. Powder charge weight changes modify two things upon shot firing: barrel time and the barrel vibrations. These changes thus distort the bore line direction at bullet's exit. But the bore line at the muzzle exit is the bullet's departure line and that, as we know, in a no-wind condition, together with the bullet speed determines the bullet destination. This Vibration effect happens simultaneously with the recoil effect. Both distortions add up.



Vibration Effect as a function of Charge Weight

Figure 2

Being concerned with Harmonics and Vibrations in all directions perpendicular to the barrel axis only complicates matters, less adding anything to our understanding. Once we understand the simplest situation, the complicated one is easier to understand.

The vibration effect will thus, for the purpose of discussion, be considered first as a simple sinusoidal vibration along a direction in which the barrel points and will be assumed to occur all within the vertical plane. A graph of a typical example is given in Figure 2. I know in real life, things are complicated than this, but we have to start somewhere.

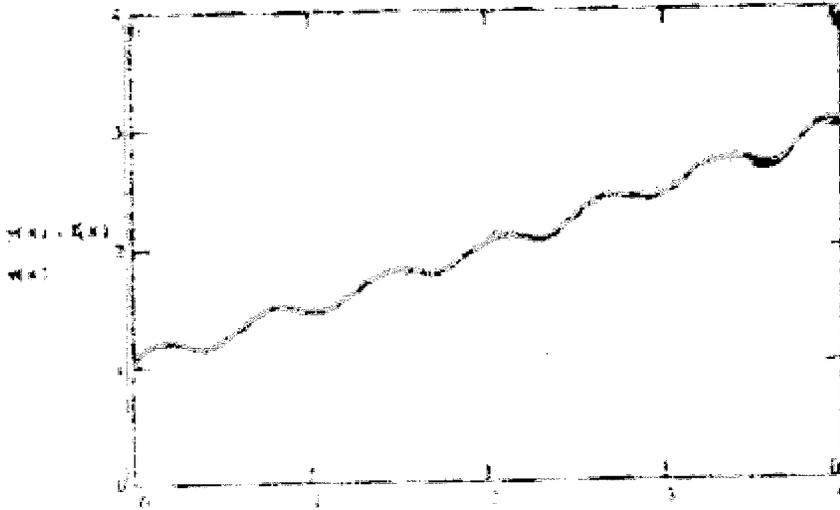
Heads up! The vibration effect is not the same thing as a vibration!

To persist to think of the vibration effect as something that happens over time only clouds to understand it. Truly vibrations happen only in time. The vibration effect here, is the effect in which barrel vibration interacts with the time the bullet spends in the barrel to cause the bullet's target impact point to vary as a function of powder mass. To increase the powder charge increases the muzzle velocity, while simultaneously decreasing the bullet time in the barrel. Changing the powder charge also changes the barrel's vibration pattern. Both work together to change the bullet impact point on the target regardless of, or in fact, in addition to, the vertical displacement by the recoil effect. The vibration effect as plotted, is a function of powder mass, not of time. Now that we know why it works, we can combine both effects together.

## The Combined Effect

The total effect of a changed powder mass, the bullets' impact point, is just that, a total.

The vibration effect adds to (by simple addition) the recoil effect to yield a graph like that shown in Figure 3. For clarity is the recoil effect shown as a dashed line. Figure 4 is just a regional curve blowup in Figure 3 with a little something added. Figure 4 shows 20 equally spaced points on the x-Axis and emphasizes those points with these x-Coordinates and then projected these points from the graph over to the y-Axis. The projected points heights look just like the pattern you get on target, when you use this incremental load development method. In this example two clumps appear. See in Figure 4 how the vibration effect cause a shot to end up lower on the target even though the powder charge and velocity were for that shot greater, than for a lower charge and velocity shot, that crawled higher.



Combined Recoil and Vibration Effect

Figure 3

#### *Where do Sweet Spots Occur?*

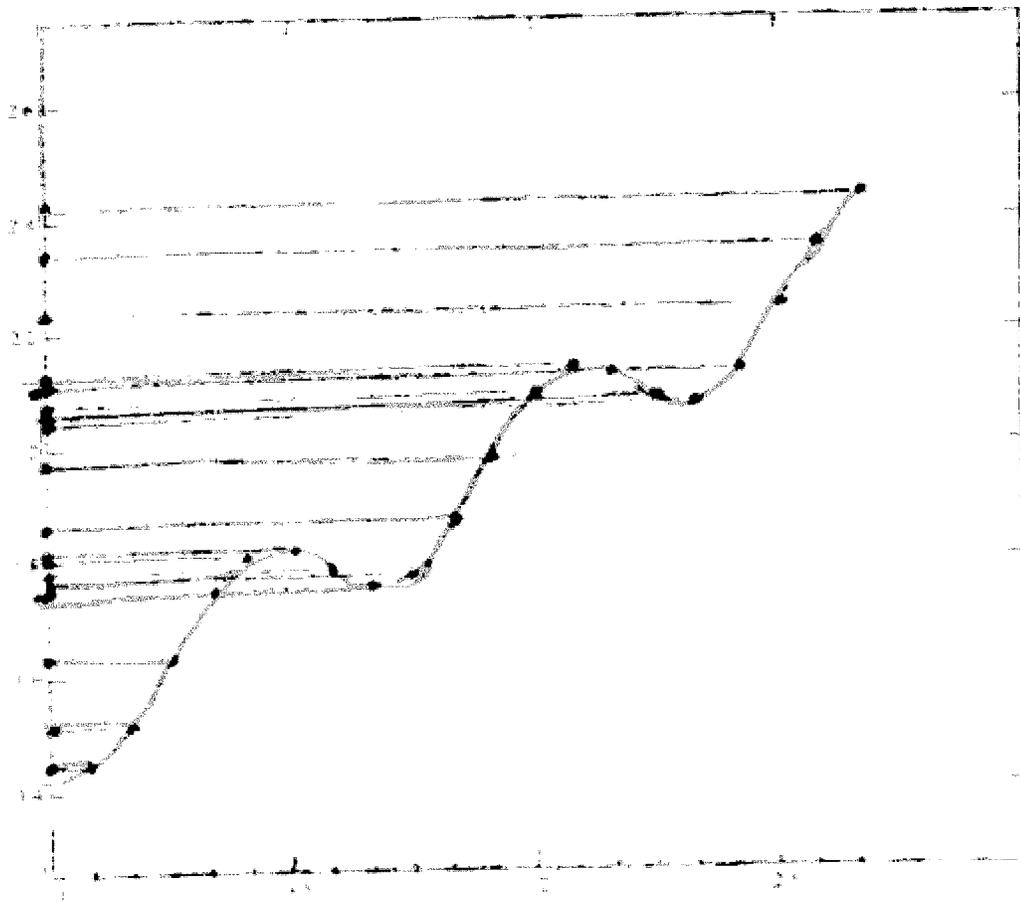
A close look at Figure 4 shows, when upon increasing loads, recoil effect and vibration effect move the impact point in opposite directions, Sweet Spots occur.

Around a Sweet Spot, as a function of increased powder charge, the vibration effect downs the barrel tip, thus descending the impact point on the target, while the recoil oppositely ups the same impact point.

Please note again, the x-Axis variable is not time, but is powder mass.

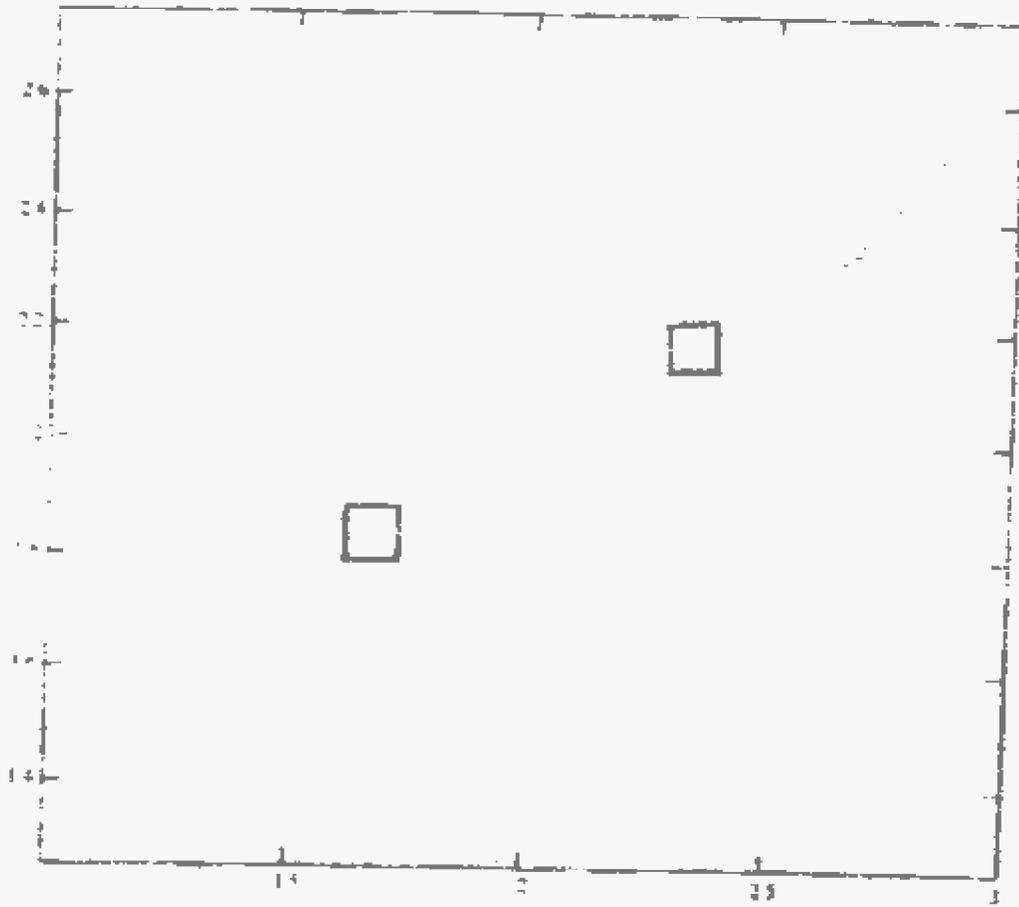
Figures 5,6 and 7 were obtained by adding "Harmonics" to the vibration effect function and then changing the "Harmonics" amplitudes and phase angles. On each these Figures, a box highlights the expected Sweet Spot graph region. On Figure 5, the Sweet Spots are small, almost nonexistent. In Figure 6. two potentially large Sweet Spots split into two small ones on either side of the downward cross point. Figure 7 illustrates a desirable situation, a large, flat Sweet Spot.

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Combined Effect Magnified

Figure 4

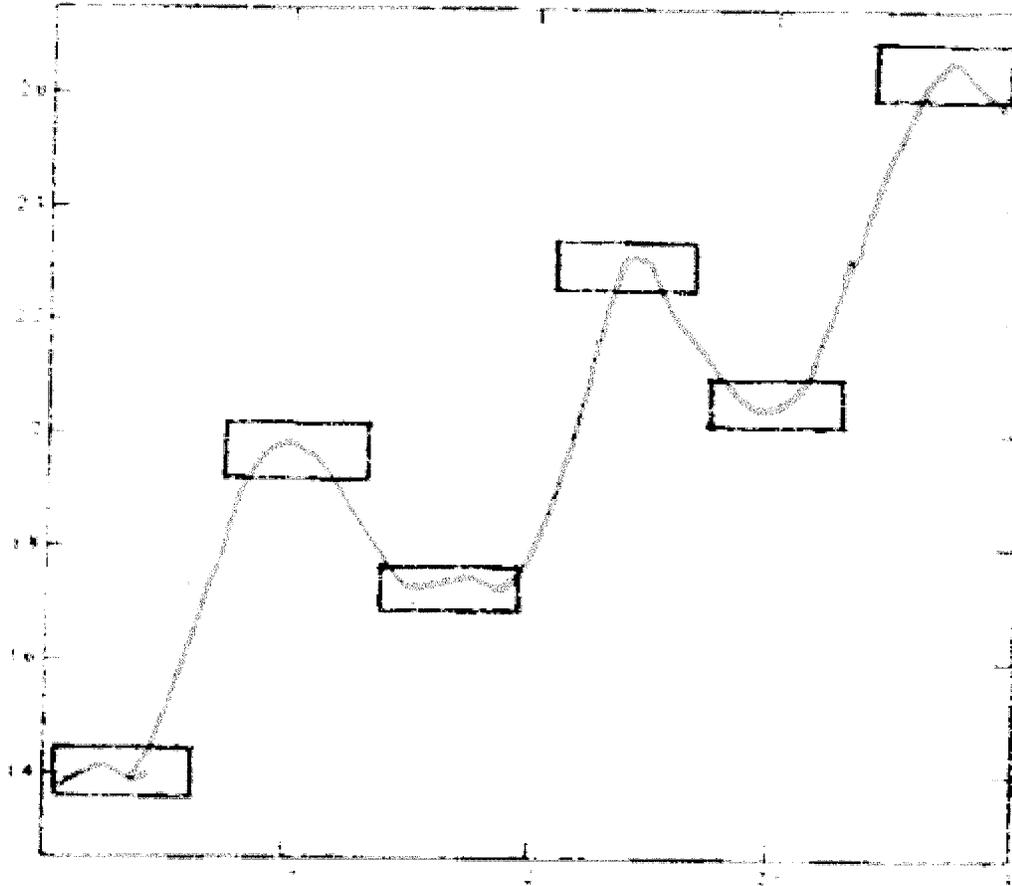


Vibration Effect: "Harmonic" Wipes Out Sweet Spot

Figure 5

In the real world things are obviously not always this nice, but they can come pretty close. The barrel may usually laterally as well as vertically vibrate. The muzzle will then wiggle in a lissajou figure, to really complicate predictions. However, almost every time, the vibration effect combines with the recoil effect yielding at least one relatively nice Sweet Spot.

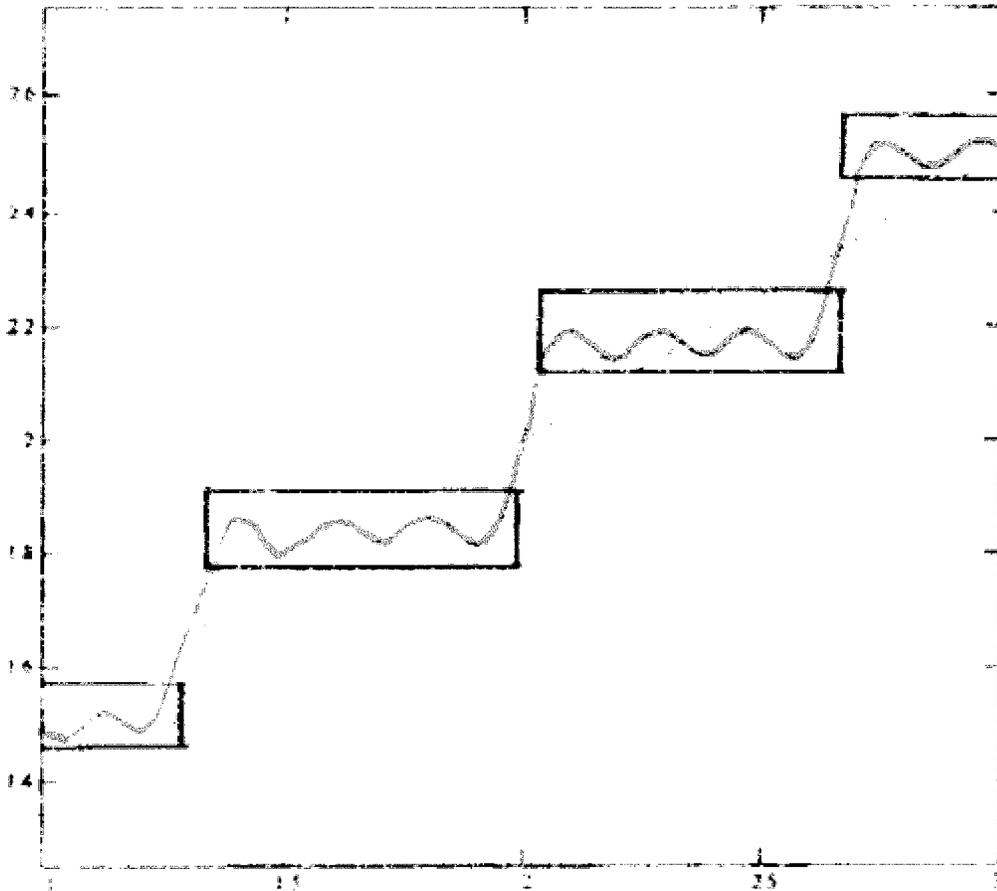
The thing that enables this method to work in the real world is, the vibration effect changes fast enough over powder variation, that at least one whole vibration effect cycle occurs within the '5.7 grain powder charge variation range'. "Vibrations" of this frequency combine with the rising slope of the recoil effect, see Figure 1, to result in combined effect regions that are almost flat, as to be seen in Figures 3 and 4. A flat impact height over powder mass curve indicates vanishing dependency on powder mass variation, hence a Sweet Spot.



Vibration Effect "Harmonic" Splits Sweet Spot

Figure 6

The group number, that a particular powder charge range yields, depends on how the vibration effect frequency relates to the velocity range in that powder charge range. I know no way to predict that. Also, if the barrel vibrates with any appreciable amplitude in the barrel's first, second or higher harmonic vibration mode, the vibration effect to recoil effect interaction may allow only one "Sweet Spot" or even none at all, much as in Figures 5,6, and 7.



**Vibration Effect "Harmonic" Creates Big Sweet Spots**

**Figure 7**

But the whole ladder test idea is not to enable you to predict your barrel vibrations but for a particular combination of bullet, primer and powder simply and practicably to enable you, to find at least one Sweet Spot, if one at all exists.

For real stiff barrels, the recoil effect may overpower the vibrations, as the barrel vibrates at such low amplitude, and thus no higher velocity shots fall in a group low. Ideally would be to somehow be able to tune a barrel, so the vibration effect exactly balanced the recoil effect and the slope of the composite curve (that actually sums recoil effect and vibration effect) at the downward cross points would be zero. I wish I knew how to do that.

To pick a load in the group middle try to choose a load near one of these downward cross points of the vibration effect. Even though we cannot separate the recoil effect from the vibration effect, the Sweet Spots tell us, when one effect tries to cancel the other out.

## The Hard Way

In a conversation with Roger Johnston of NECO I once raised this method to develop loads and he told me how he once did something with one of his Schuetzen rifles that had somewhat the same effect as the ILDM but had to be done very differently to generate enough pressure to cause the bullet to upset and seal the bore against gas blow-by, but the pressure cannot be allowed to be too high or bad things will happen: the bullet may slump; unless p-wads are used, the bullet base may be cut by the powder gas; a lot of lead may be deposited in the bore; even the bullet may strip in the rifling. So, depending on the bullet hardness, pressures have to be kept in a fairly narrow range. This restricts the charge range and available velocities. How do you obtain the best accuracy under these conditions?

Roger's answer was: If you can't tune the load, tune the barrel. He took the rifle together with a few tools to the range: A hacksaw, a machinist's square and a file and a large amount of ammunition. Opposed to breach seating each bullet, Roger shoots fixed ammunition. He shot a group and then cut a half inch off the barrel and using the file and the square re-crowned it by hand. Then shot another group until the rifle shot the way he thought it ought to. He says he endured a lot of rude comments from the peanut gallery, but took satisfaction in consistently beating most of them in matches.

This is definitely no easy way to gain accuracy, but perhaps the only way to get to a Sweet Spot for a fixed load. However, it may not be the method of choice for everybody. How good are you with a file? My hat is off to Roger. May he bask in the reflected glow from my pate.

## ILDM Results from the Real World

Back in early 1996 I decided I needed to see if I could develop some better loads for the rifle I used to shoot over the course. After all, re-barreled the rifle and switched to using moly-coated bullets, so some new load development was in order. I decided to try all three of the standard lower - weight Match bullets (150, 155 and 168 grains ) available from Sierra for the .308 and their then-new 175 grain Match bullet as well. I called up M. L. McPherson and arranged to go over to Cortez on his Club range with him. He too, had some range work to do, so we settled on a time and day. The Cortez range is only 70 miles from my house instead of the 200 plus miles to the range down at Los Alamos, so going over to shoot with Mac meant fewer miles to drive. I ended up making two trips to Cortez to get everything done, all because Murphy ( you know, Murphy's Law?) showed up to do his thing.

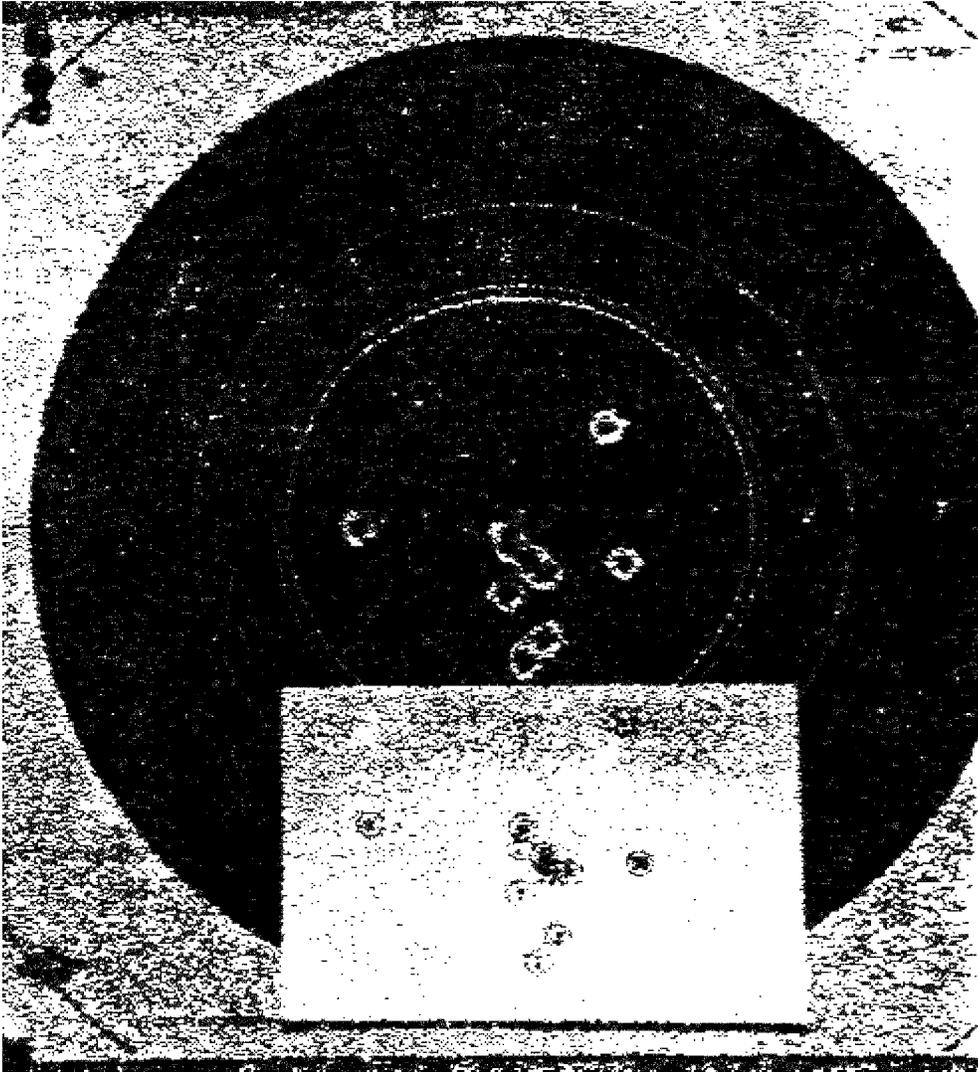
I started the test with the Sierra 150 grain Match King bullet with 41.0 grains of Varget for a starting load. The chronograph did not "see" the first shot, but it was nicely on target.

For this test I used something new to me, that Mac provided, one of the new Shoot N-CT" target centers made by Birchwood-Casey which I described earlier. Using this made it easier to tell which shot hit where.

Things went along great in that first test until the 9<sup>th</sup> shot, that went way out of the group to the right; the 10<sup>th</sup> went way left: and the 11<sup>th</sup> went way out the top and right. A

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quick rifle inspection showed the Bloop tube couple cracked, because I habitually over tightened the clamp screws. That ended my shooting for that day, but just those few shots gave me enough data, that I could pick a load for the 150, that I could use with confidence and success.



The target for those 11 shots is shown in photo 1. That little group in the target middle has six shots in it with powder charges varying from 41.6 to 43.1 grains of Varget and measures 1.04 inches on the outside. Subtracting 0.308 for the bullet diameter yields 0.366 group, since it was shot at 200 yards. Not bad for iron sights and a 15 grain variation in powder charge weight, huh?

Note: Each four tests shown in Photos 1 through 4 were shot at 200 yards. These four photos also show the form on which I recorded the data from Ladder tests. I find this form to be very useful.

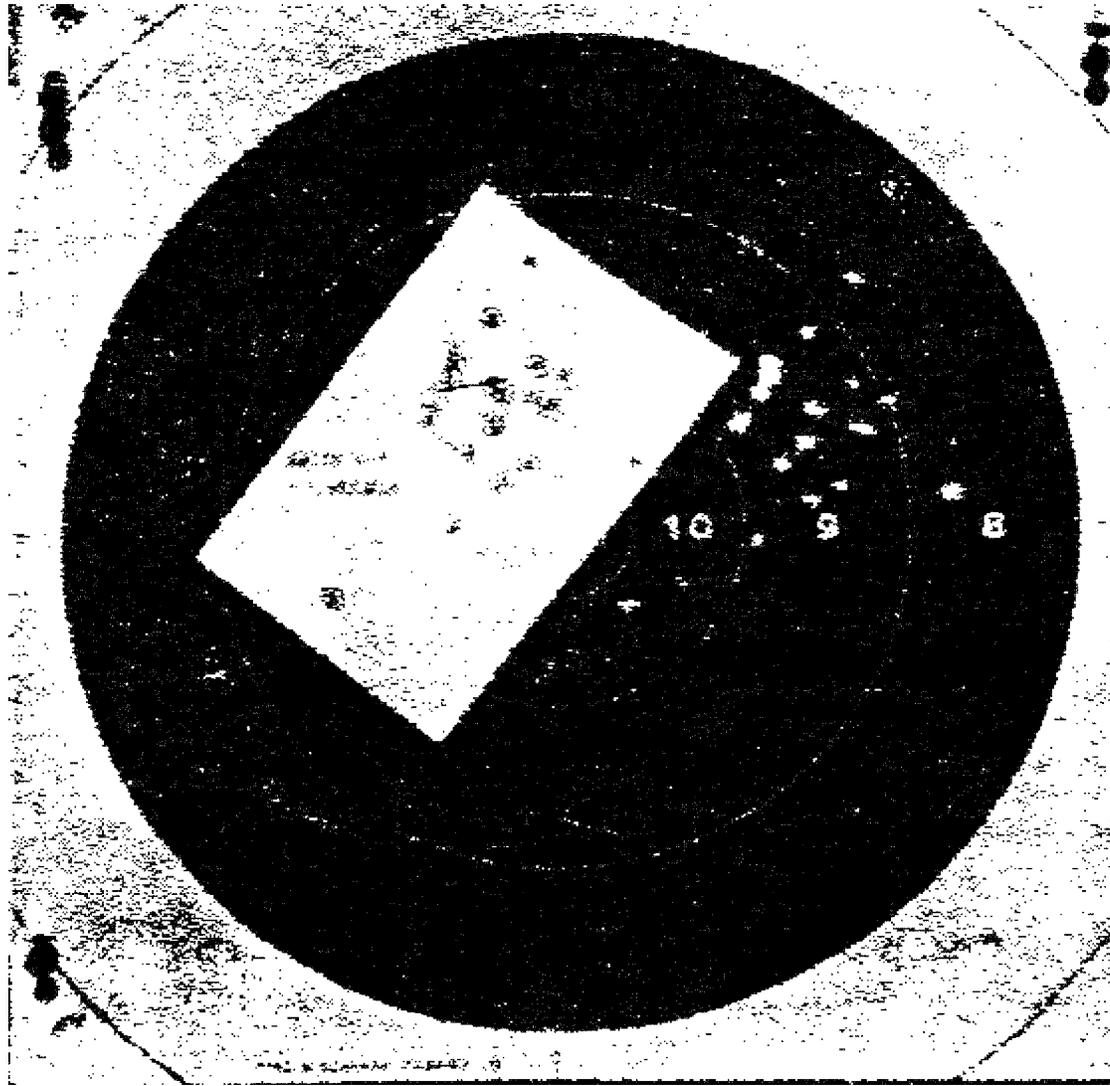
I decided to use 42.5 grains of Varget as my load for the 150 grain bullet. That was the only load that I have ever used, since that test was for both standing and sitting rapid fire at 200 yards. I felt no need to test heavier powder charges. One of the reasons I wanted to use the 150 grain bullet in the first place was to minimize recoil for rapid-fire.

I doubt, I could have gained much better accuracy. There was just no need for more velocity and recoil.

## The Rest

After a Bloop tube problem I modified the rifle to fix it, I called Mac and set up another date to test. This time I tested the 155 grain Palma bullet, the old standard 168 Grain Match king and the new 175 grain Match King. The results were interesting. With the 155 grain Palma bullet and Varget, 16 shots went into a diamond shaped cluster 1.837 inches wide by 2.072 inches tall (that's Center to Center), but in the middle of all that, shots number 5 through 9 were in a Cluster measuring 0.488 center to center. With Shot #7 having a 41.8 grain charge and shot #8 at 42.1 grains, I just arbitrarily picked 42.0 grains as the charge to use with the 155, if that was the bullet I decided to use, as turned out to be. The target for the 155 grain bullet test is shown in Photo 2.

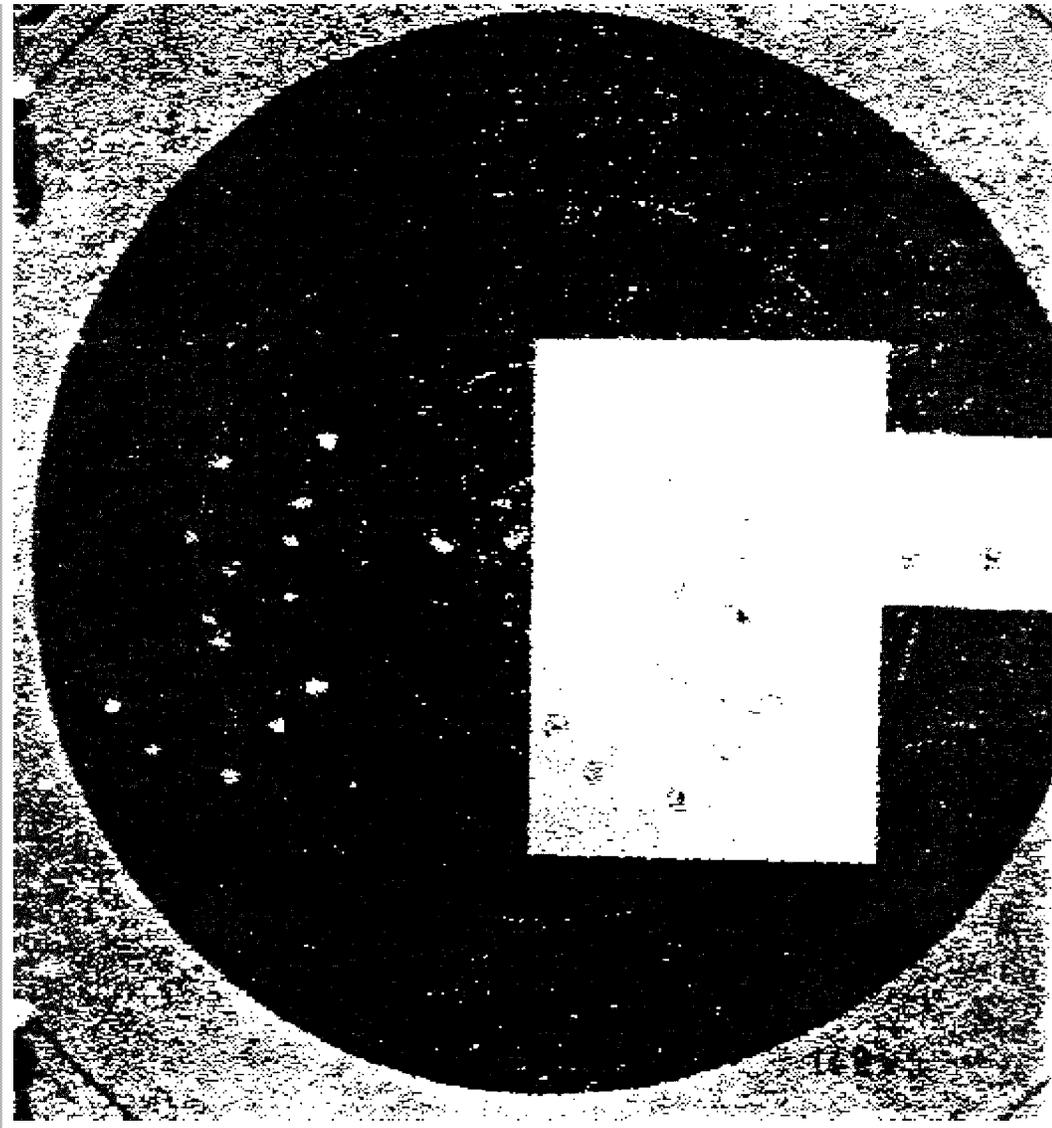
Things were not so good with the 168 grain Match King. Velocities were erratic. For each 0.3 grain powder increment the velocities seemed to increase about 15 to 20 feet per second on the average, but shots #5 and #10 jumped out of their progressions and out of the forming groups. Also, there was way too much lateral variation than could be attributed to the little wind there was. If I had to pick a load for the 168 it would be 42.0 grains (shot #8 is 42.1 grains). Shots 6, 7, 8, and 9 formed a 0.778 group. Not bad, but no where near as good as found with the 150s and the 155s. I prefer to find a five or more consecutive shots group, if I can. Photo 3 shows the target shot with the 168's.



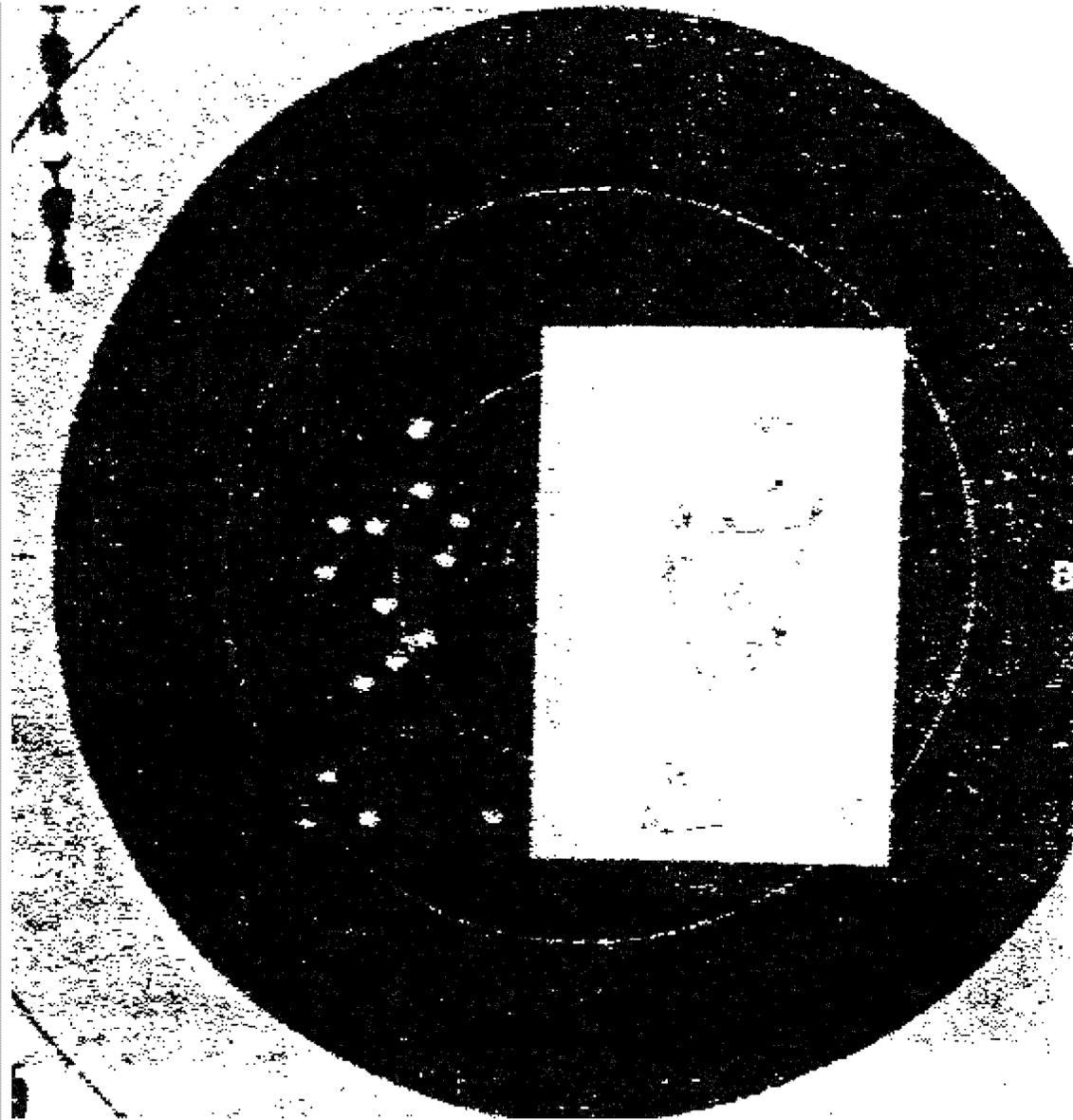
I also tested the then-new 175 grain Match Kings. I had shot them at 300 Yards in one match and performed fairly well, but felt, I could do better than the load I used in that match. As you can see in Photo 4, there are three distinct groups on the target but no really close five or more consecutive shots. There were some nice three shot groups and one middling good four shot clump. Shots 2, 3, and 4 edged a nice little 0.403 triangle and shots 5, 6, 7; and 8 went into 0.665. The best five shot group comprised shots 11, 12, 13, 14, and 15 measuring 0.720.

I picked the 155 grain Bullet to use at 300 yards. With that load, I shot my first ever clean prone rapid fire at Camp Perry to boot. I also use this same load for prone slow fire when shooting reduced distances. With this load last year I shot a 199-7X in the prone slow fire stage of a 100 yard match, and the one 9 was my fault.

Incremental Load Development Method



## Incremental Load Development Method



While using the least amount of components in the load development process, I believe Creighton's Incremental Load Development Method, the ladder test, is the only way to develop the most accurate load with a particular primer + powder + bullet combination. Of course the objective is to develop an insensitive load to minor in charge weight variations, that occur when throwing all charges with a powder measure. With weighed charges, that insensitivity should not matter, but can in practice. It does not hurt to have your load sit in the Sweet Spot middle, even if you weigh the powder. Using the Incremental Load Development Method, I developed the most accurate loads I ever shot in competition. Using those loads, I shot the best scores I ever shot. That is good enough for me.

Till next time, Keep'em in the Center.

Randolph Constantine  
Lost Axe Ranch  
47951 1 U. S. Hwy 160

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Bayfield, CO 81122  
U.S.A.

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