Accurate loading of cast bullets for the 6.5 Swede

The 6.5 Swede in its original milsurp form is castigated by many as very difficult to load accurate cast bullet loads for, especially at what is considered to be “high velocity”. If you have an original military M96 or M38 that shoots quality jacketed loads into sub 2 moa then it is also reasonable to expect quality cast bullet loads to shoot into the same 2 moa, albeit at a much lesser velocity than the jacketed bullet loads. With the 6.5 Swede most cast bullet shooters consider any velocity above 1500 fps as “high velocity”. Many have developed very decent loads that push 1800+ fps. However to get into the realm of 1900-2400 fps with a 6.5 Swede and maintain 2 moa accuracy at 100 yards and beyond takes some doing and most often is not doable with components at hand.

The problems are several; first there is the fast twist. Normal cast bullets accuracy is adversely affected by RPM above a certain RPM threshold. That threshold is usually in the 120-140,000 RPM range depending on bullet design and the loading components used. Thus with normal cast bullet loads accuracy with the 6.5 Swede will be best in the 1200 to 1500 fps range with cast bullets. Going above this RPM threshold very quickly can have an adverse non-linear affect on accuracy. Then there is the odd size of the 6.5 Swede’s groove depth. Most are .266 to .268” groove depth with a .258 -.260” bore. Most modern 6.5 moulds do not cast bullets large enough for a proper fit as they are made for the modern .264” groove depth of today’s 6.5 caliber rifles. These modern moulds do drop cast bullets that still provide yeoman service with loads in or under the RPM threshold. However, if you want to increase the velocity above the RPM threshold and maintain accuracy you must have a mould that casts bullets which fit the groove depth and/or the bore of your particular 6.5 Swede rifle. A last but not insurmountable problem is the generous chamber dimensions of many milsurp 6.5 Swede rifles, especially the M96.

Let us address the steps, equipment and components that will give adequate cast bullet accuracy up through 1800+ fps and give you a solid base to attempt higher velocity if desired. We shall assume that you already have the normal array of reloading equipment to load ammunition and to cast bullets.

The cartridge case;

Most milsurp 6.5 Swedes have generous chamber dimensions. Not only does headspace differ considerably between many older M96s and the newer M38s but the chamber necks are usually of large diameter and considerably longer than most “trim to lengths”. For cast bullet shooting ideally we want a concentric neck that fits the length of the chamber neck and with walls of sufficient thickness that only a small amount of expansion is done when the cartridge is fired. This lessons the obturation of the base and shank area of the bullet to a much larger diameter than the throat. Thus less distortion of the bullet when pushed up into the throat with the base of the bullet (GC) also tends to stay square to the bore for better accuracy. Most factory 6.5 Swede cases have fairly thin necks. There are a couple exceptions but mostly on a lot to lot basis. It is best to form the cases from milsurp 30-06 cases. By doing such you can have the thickest necks possible and also trim them to the proper length for your rifles chamber.

I like to use once fired ’06 cases of one lot or headstamp. I clean the cases, deprime them and remove the crimp if necessary. I then initially form them in a 8x57 form die and the excess case length is cut off. I then anneal them. The preformed cases are then FL sized in a 7x57 die with the depriming stem removed. I then sacrifice one case by trimming it way too short to adjust the headspace of the 6.5 FL die to match the headspace of the rifles chamber. I begin to size this case down a little at a time (I adjust the FL die in ¼ turn at a time), trying to chamber the case in the rifle between each sizing. Once the case is sized so I have a “crush fit” closing of the bolt on the case the rest of the the cases are then run into the thus adjusted 6.5 Swede FL die. All of the cases then will have this “crush fit” when chambered. This minimizes case head stretch at the case web during fire forming. It also helps keep the case centered during fire forming. Additionally the depriming stem for the 6.5 FL die is adjusted so the expander is just below the case neck as it is pulled out of the die. This is like the position of the expander in Forster/Bonanza Bench rest dies and keeps the necks a lot straighter (concentric) as they come out of the sizing operation. Of course the inside of
the necks are well lubed for this sizing. One of the FL sized cases is then trimmed to length by trimming only a little at a time until the bolt just closes on the case when chambering. I then chamfer the outside of the necks and use a Lyman long taper case neck reamer to ream the inside of the case mouths.

The cases are ready for fire forming. Everyone knows that most all ’06 cases are a few thousandths smaller in the head diameter than Swede cases (though many modern Swede cases are now the same diameter as ’06 cases). To get even expansion at the expansion ring I use a small one thickness wrap of cellophane tape around the case head. The cellophane is only about ¼” wide and is necessary only for fire forming the case. The cellophane centers the case head in the rear of the chamber for the initial fire forming. The cases do need too be fire formed before any serious cast bullet load development can begin. I use a top end load to fire form my cases with jacketed bullets (mostly with bulk Remington 120 gr bullets). I usually like to fire 3 such fire forming loads in each case to ensure complete fire forming of the case to be used for cast bullets. I use a permanent marker and mark the rims in 3 spots 120 degrees apart. The first mark is usually over the headstamp arsenal initials and this first mark is placed up when the case is initially fired. Then on each additional firing I simply rotate the case to the next mark. Of course the cases are neck sized for the subsequent reloads. I may or may not anneal the necks again. I also then outside turn the necks a very small amount to ensure concentricity.

Additionally I will drill out the flash holes with a #30 (#28 being the largest drill to use) to prevent the attendant shoulder setback caused by the primer explosion with reduced loads. If I do not drill the flash holes out I at least then uniform and deburr them with a Lyman tool. All of this case preparation may seem tedious and a pain but if one wants the best accuracy with cast bullets then a proper fit of the case neck is necessary. This is especially the case if you are going to push the RPM threshold into higher velocities. The bullet needs all the support in the case neck it can get. The use of properly formed 6.5 Swede cases using ’06 cases is the best way to do it.

**Sizing the case;**

Once you have gone to the trouble of forming 6.5 Swede cases from ’06 cases it is ridiculous to ruin them by FL sizing them or by even attempting to “partial size” them. Doing either will only lead to frustration with lack of accuracy and negate the benefits of the properly fitted case to your rifles chamber. Doing either will also lead to early incipient case head separation. Obviously you will need to neck size only. The Lee collet die is a good one for this but with the thicker necks of the formed cases it may not give consistent results of neck tension. A regular NS 6.5 die can be used but I’ve found a custom expander for the M-die will then be necessary if you do not want to bend or distort softer alloyed cast bullets during seating. Either bending or distorting or both during seating is easy to do with the long thin 6.5 cast bullets. Bent and/or distorted cast bullets are not conducive to accuracy so best they not be bent. With the uniform thickness and concentricity of the formed case I’ve found the best method to neck size is with bushing dies. I use Redding bushing dies for this but at least 2 other makers of bushing dies are available. I’ve found that with a small assortment of different diameter bushings I can size the cases just enough to give perfect neck tension with no distortion of the bullet when seated. With a proper reaming of the sized case mouth to accept the base of the cast bullet with the Lyman minimal taper neck reamer (VLD style) the use of an M-die is also many times not necessary. With the use of the proper bushing there is no need for an expander and the Lee Universal expander will work fine to slightly flare the case mouth so the cast bullet can be easily seated if the case mouths are not reamed. The Lyman M-die of 6.5 size also works fine.

**Primers;**

The selection of what primer to use may come down, particularly these days, to what you can get. In many recent tests of primers I’ve found that most regular LR primers work equally well. Many times though a magnum or magnum type primer (such as CCIs #34s) will not work best with many powders. It is best to use regular primers with cast bullet rifle loads unless you are using very slow burning powders (slower than RL22) or most ball powders (medium and slow burners). In extensive testing with an Oehler M43 which measures external and internal ballistics including pressure I have found little to no difference between CCI 200, Federal 210, WLRs and Remington 9 1/2s with cast bullet loads using powders from Bullseye up through H4831SC. As mentioned, with slower powders
or medium to slow burning ball powders, the hotter magnum type primers might be best. I read and have been told many times that primers of very low brisance such as large pistol primers can improve accuracy. Most often it goes something like this; “I was working up a HV load in my ’06 and at 2000 fps the accuracy was 4 moa. When I switched to a “such or such” low brisance primer the accuracy went back to 2 moa.” Well there is some truth to that but I’ve found through considerable that most often the 4 moa load was above the RPM threshold and when switching to a low brisance primer the velocity/RPM dropped back down to within the RPM threshold. I’ve found that there can be as much a 200+ fps different with some powders, particularly with the slow burning powders, simply by changing primers. The lowering of the velocity from 2000 fps down to the 1800 fps range and back under the RPM threshold is actually what improved the accuracy. Thus it can be said that changing primers can affect accuracy. However if we work up a load with one primer and accuracy is good then by switching to another primer is there seldom found an increase in accuracy unless we are bouncing above and below the RPM threshold. I use and always suggest to others that a good regular LR primer like the CCI, Federal, WLR or Remington will work quite well in the 6.5 Swede with most powders.

**Powder selection;**
Selecting an appropriate powder for the 6.5 Swede to use with cast bullets can be confusing. Many times the selection is made based simply on the powder(s) we have available on our shelf at home at the time. This many times works out fine if we have an appropriate powder available for the velocity range we are looking for and weight of cast bullet we have. With cast bullets of 120-130 gr and a velocity of upwards of 1400 fps Unique or a similar burning rate powder will work fine. For velocities up into 1600-1800 fps then the slow burning end of the pistol powders and the fast burning end of the rifle powders work very well. Here we find 2400, 4227, 5744, 4198 and 4759 to work well. If we want to shoot a cast bullet of this weight faster then we must really begin to look at acceleration (the time/pressure curve) that the powder will have on the cast bullet. For higher velocity loads we want to accelerate the bullet to that velocity over a longer time. For this we must look at the medium and slow burning powders. H4895, 3031, 4064, Varget, RL15, RL19, 4350 and H4831SC are the ones to try here. Slower burning powders and even some of these will reach 100% case capacity/loading density before velocities get into truly high velocity for a 6.5 Swede. Another problem with slow burning powders is erratic ignition or pressures not getting high enough for consistent ignition. The 6.5 Swede cartridge is not one of large capacity so a balance must be reached between the weight of the cast bullet, the burning rate of the powder and consistent ignition. The use of magnum type primers may help a little here with the slow burning powders that are giving 90 – 100+ loading density.

With cast bullets of 140+ gr in weight the selection of powder to use is a bit different. For the low end loads the slow burning end of the pistol powders and the fast burning end of the rifle powders work best. Here very good accuracy can be had in the 1400 – 1600 fps range. If everything is done correctly then very good accuracy up through 1800 fps can be had with those powders. However, most are finding the best success with the slower burning rifle powders. They are also finding that such very slow burning powders that give 90 – 100+ loading density are working well. Again, particularly when using such slow burning powders, that balance between loading density, velocity and consistent ignition for the velocity desired must be found.

**Bullet selection;**
If we are keeping the velocity of our selected cast bullet down in or under the RPM threshold then just about any quality mould of regular design will give decent accuracy. However if we are selecting a cast bullet for the 6.5 Swede at velocity/RPM above the RPM threshold then that requires some thought must be given to the selection to the design of a cast bullet. If we want the “best” accuracy out of our 6.5 Swede, even at a velocity/RPM within the RPM threshold then the same requirement for design of the cast bullet applies. The selected cast bullet must fit. It is that simple. This “fit” must be from the bottom of the case neck, in the throat, against the leade and into the bore if the selected cast bullet has a bore riding nose. If we are pushing for best accuracy and high velocity/RPM then the GC must not extend into the case below the case neck. The base/shank of the cast bullet needs all of the support it can get during acceleration. It must not be allowed to bend, rivet or get
gas cut. Also important is keeping the bottom of the GC square with the centerline of the bore. If the base gets crooked then the "launch" from the muzzle will not be even and inaccuracy adversely affected. We must keep the cast bullet centered and concentric and the best way to do that is to keep the entire cast bullet in the case neck and the chamber throat. If you truly want to get into high velocity then a long bore riding nose unless it has a very tight fit is not conducive to accuracy at really high RPM.

Most milsurp 6.5 Swede's have long throats. Most of these are at or slightly larger than groove diameter. The most accurate cast bullet is one that fills the throat length with the shoulder/front driving band slightly engraving on the leade. If the cast bullet has a bore riding nose then the nose should be a tight fit with some slight engraving of the nose by the lands. I have come to avoid cast bullets with long bore riding noses if I want to get into high velocity/RPM with any accuracy. The basic idea here is to get maximum support of the entire cast bullet from the base to the ogive. This will allow for minimal bending and obturation during acceleration.

Two commonly found bullet designs for the 6.5 are Lovern designs and bore riders with long noses. The common Lovern designs are Lyman’s 266455 and 266469. The common bore riders are Lyman’s 466673, RCBS 6.5-140-SIL and Saeco’s #264. There is also a "Cruise Missile" design available as a special order from Lee. My experience with numerous of them has narrowed my choice down to 266455 which is a Lyman Lovern design with no bore riding nose. That 266455 design fits the case neck and throat of all 4 of my 6.5 Swedes perfectly and with no bore riding nose to contend with it has proven to be the most accurate design for the 6.5 Swede up through 2000 fps. Cast of most alloys it runs from 125 -130 gr in weight with GC and lube. It has provided me with the best accuracy across a broad spectrum of velocity in the fast twist Swede. Many find good accuracy with the other designs but most often it is in or below the RPM threshold. The Lyman Lovern design gives the best accuracy at higher velocities from the 6.5 Swede and also the same basic design gives the best accuracy in other calibers as well.

**Bullet Alloys:**
There are numerous schools of thought on this. Some like to use hard alloys and some like their alloys soft. Others like them of medium hardness in the 16-18 BHN range. I have found that best accuracy, especially at higher velocity is best achieved with an alloy that is ductile. In other words it is not brittle. If one is keeping velocities down in the 1400-1500 fps range in the Swede then an alloy of straight WWs usually suffices. Though I like to add 2% tin to the WWs. This changes the composition of the alloy making the cast bullets a little more ductile and the bullets cast better with less rejections due to non fill out. My best accuracy alloy with cast bullets at high velocity not only with the Swede but with other caliber/cartridges has been with an alloy of WWs + linotype at a mix of 60/40 or 70/30. This gives a BHN of 18-20 with air cooled bullets. They are ductile and hold up well to high acceleration and velocity. I have been using WWs + lead at a mix of 50/50 for a long time in higher velocity hunting cast bullet loads. I have found accuracy to be excellent for the first 5-7 shots out of a cold clean barrel. Problem is that fouling quickly builds and then accuracy deteriorates. Thus such bullets cast of that soft alloy are not good for general shooting but are great for hunting where more than 5-7 shots are not fired anyway. Again a balance must be found here between the bullet being ductile instead of brittle, the alloy being able to withstand the acceleration at the velocity desired and the terminal impact requirements.

I cast my 6.5 bullets in a single cavity mould. This gives the most consistent cast bullet which is conducive to the best accuracy. I then give them a visual inspection for non fill out or wrinkle with all defects causing rejection. For high velocity/RPM loads I then weight each bullet and reject all bullets not within a +/- .2 gr of the mean average of the lot. This means a larger rejection percentage of bullets but the accuracy results at high velocity/RPM justify it.

**Bullet lubes:**
My experience based on numerous side by side tests of numerous bullet lubes at low, medium and high velocity, show that there is little difference between many lubes. Let me say also that there are some bad lubes out there for high velocity use in rifles both commercial ones and home concocted ones. The time to test a bullet at high velocity/RPM above the RPM threshold is not also the time to
test a home concocted lube. Run the high velocity/RPM test with a known lube that works and then test the home brewed concoction against that. There are numerous good commercial lubes that work at high velocity/RPM such as Javelina, XLOX 2500+, Carnauba Red, LBT Blue, LBT blue soft, and Orange Magic. There are probably others as well but those are the ones I have specifically tested and find them to work equally well. If you are using a bad lube and switch to a good one then a great improvement in accuracy can be had. However, I have found through meticulous tests at high velocity that if you are using a good lube to begin with and switch to another good lube then little to no improvement in accuracy is likely to occur with such high velocity/RPM loads.

Gas Checks;
We basically have 4 types of GCs to pick from. Hornady, Lyman (reputed to be made by Hornady), the GB GCs and the home made ones by various tools. Quite frankly I use all of them and they all give very accurate results if the velocity/RPM level is below the RPM threshold. However when we get above that threshold then some things must be considered. The GC for such loads must have a flat inside bottom for the shank of the cast bullet to seat squarely into. The GB GCs do not have flat inside bottoms and must be flattened with a well fitted punch. I find little difference between Hornady and Lyman GCs, perhaps because they are of the same make. Some anneal the GCs but I do not. I tried it several times and found no benefit in accuracy. One thing that is of benefit to accuracy is the need to seat the GC squarely on the bullet shank. I use several methods to do this but mostly seat GCs as separate step to ensure it is done right. A Lyman GC seater for the 450 Lubrasizer works for most of my needs.

Sizing the cast bullets;
Once the GC is properly seated I prefer to size the bullet in a push through sizer if the bullet is to be sized .001’ or more. This also crimps the GC on. A light coat of spray case lube on the cast bullets prior to this initial sizing makes them size easily. I like to size the bullets in the push through to the same size as the H die in the 450 Lubrasizer so that there is no bending or distortion of the bullet when run through the 450 for lubing as the H die is then not sizing the bullet. When lubing the bullets in the 450 I run the bullets into the H die twice to ensure the lube fills all of the lube grooves completely.

I have 4 milsurp 6.5 Swedes. They all have throats of .266-267” diameters. I size the 266455s at .266”. If they are .0005” over that then the bullets will be pushed back into the case when the round is chambered. Cast bullets for the 6.5 Swede really need to be sized to that close of a fit in the long throat of the Swede for the best accuracy, particularly at the higher velocity/RPM.

Seating the bullets;
I’ve used several 6.5 Swede seating dies over the years and they all work fine with .264 diameter bullets. However most of them don’t work well with .266 or larger cast bullets and most often the larger cast bullet sticks in the seating die and does not seat properly. The seating die can be honed out to allow the larger bullet but this might cause alignment problems with jacketed bullets (yes I do still use them). My solution was a simple one. I use a 7x57 seating die. I thought I might have some concentricity problems but given the neck sizing method I use to adjust neck tension and the long taper neck reaming the 6.5 cast bullets seat straight in the 7x57 die.

Testing;
Testing should be done from a solid bench rest using proven shooting techniques. Testing should be initially done at 100 yards with additional test at 200 yards. Your accuracy goal for cast bullets should be the same as the rifle is capable of with good jacketed bullet loads. Shoot 5 five shot groups with the quality jacketed loads. If the best group is 1.5” then that is good but not your goal. If the average group size is 2” then that still is not your goal. If the largest group was 2.5” then that is your goal; to shoot consistent 5 shot groups with cast bullet groups of 2.5” or smaller at 100 yards. You and your rifle may shoot better than that as I was just giving an example. Your goal and expectations need to be based on your rifles capability in conjunction with your own shooting ability. Because some one else may get 1” groups with their 6.5 Swede does not mean that your rifle and/or you are capable of that. The potential may be there with the rifle but we, the shooter, may not be up to that potential yet. Thus we must accept what our capabilities with our rifle are and set our goal
for accuracy to match that capability.

The point is the smallest group you shoot is not the accuracy potential of your rifle and neither is the average group size. The largest group is the actual accuracy potential because you never know when you will shoot that size of group. You can’t say; “I’m going to shoot the smallest group now.” Nor can you say; “now I’ll shoot an average size group.” You just shoot the best you can and the group will be what it is. This is because 25 shots (the aggregate of the 5 five shot groups) going into a 2.5” group is actually indicative of the true accuracy potential of that rifle with that ammunition with you shooting it. This is why you should use a good quality jacketed bullet load to conduct this test. It gives you the accuracy potential of your rifle and you and thus you can best set a practical and obtainable accuracy goal for your cast bullet loads.

A chronograph should be used with your load development. They are inexpensive and easy to use. They also tell you quite a bit about your loads that a single group will not tell you. They give you the actual velocity of your loads instead of a “guesstimate”. However the best thing about the chronograph is that it measures the consistency of the ignition. This is done by measuring the Extreme Spread and the Standard deviation. The smaller the ES/SD is the more consistent the load. Consistency of ignition is a key to accuracy especially at high velocity. However, many pay to much homage to the SD. I have been comparing the ES to SD and to the actually accuracy of many, many different loads out of many, many different rifles since ’89 when I got my first Oehler M35P that gave both the ES and the SD. My previous chronograph (also an Oehler) gave only the ES. I like to look for a load that gives the lowest ES with an SD that is 25 – 45% of the ES. Too many times have I had shot strings that gave a low SD with a high ES to look solely at the SD. Such strings of shots usually have one or two flyers that cause the higher ES and also show up as flyers on the target. Both the ES and the SD must be paid attention to. Use a chronograph during testing otherwise you are just guessing at velocity and the consistency of the load.

Work up your cast bullet loads initially in 5 shot groups. Switch to 10 shot groups when things look good with a particular load. If things are really looking good with a particular load and it is within your goal then shoot 5 five shot groups of that load or 3 ten shot groups. Either of those tests will show if the load is really consistent and accurate. If the load is consistent and is at or above the RPM threshold (140,000 RPM) then I suggest a 10 shot group at 200 yards. If the load is indeed good then the group size will be closely linear in size to the 100 yard group size. For example if the 100 yard group is 2” and the 200 yard group is 4- 4.5” then all is well. However if the 200 yard group size is not linear (say it is 8-10”+) to the 100 yard group size then the bullets are unbalanced during acceleration and the RPM is causing the attendant inaccuracy during flight.

**Conclusion:**

Using the above techniques I have loaded very accurate cast bullets loads in numerous milsurp 6.5 Swede rifles. There are other techniques that perhaps work as well. There is no secret to any of the techniques I use as all of the information is available in Lyman’s Cast Bullet Handbook, the NRA Cast bullet supplements and numerous other publications. I do not go out in my garage in the dark of the night during the witching hour and brew up anything. I have no secrets, no myths, no old wife’s tales and use no witchcraft. What I use is just good loading techniques coupled with an understanding of internal and external ballistics. Anyone with some experience in reloading and casting bullets should be able to do what I have done. Keep in mind that the 6.5 Swede is indeed a difficult cartridge to load cast bullets for simply because many load them at too fast a velocity. The fast twist (1 turn in 7.5”) results in extreme RPMs as the velocity increases. Unless all is done correctly in the casting and loading getting accurate loads above the RPM threshold can and is difficult. I, and others, have gotten very good accuracy up through 1800-1900 fps out of a couple 6.5 Swededs. However I have not been successful with a consistently accurate load over 2000 fps. Several loads held the promise of a young girls good night kiss but then her dad opened door, i.e. I was not able to consistently duplicate any consistently accuracy load above 2000 fps. When a couple promising loads were tested at 200 yards the groups (10 shot) went from 2” or so (with a scope sighted 6.5 Swede) at 100 yards to 12-20” groups at 200 yards, hardly linear by anyone’s stretch of the imagination. I very seldom could even reproduce the 2” group at 100 yards. Velocities here were 2000 - 2200 fps. This is not to say that I will stop trying as the 6.5 Swede rifles are fun to shoot and probably close to the ultimate
challenge in obtaining accuracy at high velocity with cast bullets in a rifle.

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